STX

Theory/Maintenance Manual

MOTOROLA

FOREWORD

SCOPE OF MANUAL

This manual offers only theory and maintenance information for the equipment listed. Service diagrams, parts lists, and printed circuit board details are not a part of this manual, but are contained in a supplementary service manual as listed on the contents page.

NOMENCLATURE

Motorola equipment is specifically identified by the model number on the nameplate.

NOTE: Be sure to use the entire model number when making inquiries about your equipment.

Identifiers have been assigned to chassis and kits. Use these identifiers when requesting information or ordering replacements.

PRODUCTION CHANGES

When production and engineering changes are incorporated into the equipment, a revision number is assigned to the chassis or kit affected; -1, -2, -3, etc.

The chassis number complete with revision number, if any, is stamped on the chassis at the time of production. The revision number becomes an integral part of the chassis identifier. Revisions, if any, are listed on the schematic diagram.

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Changes which occur after a manual is printed are described in the Manual Revision. These bulletins give the reader complete information on the change including pertinent parts listing data.

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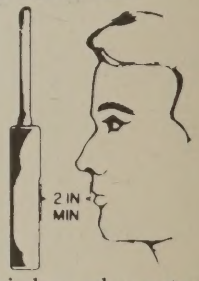
SAFETY INFORMATION

The United States Department of Labor, through the provisions of the Occupational Safety and Health Act of 1970 (OSHA), has established an electromagnetic energy safety standard which applies to this equipment. Proper use of this radio will result in exposure below the OSHA limit.

DO NOT hold the radio with the antenna very close to, or touching, exposed parts of the body, especially the face or eyes, while transmitting. The radio will perform best if the microphone is two or three inches away from the lips and the radio is vertical.



DO NOT hold the transmit (PTT) switch on when not actually desiring to transmit.

DO NOT allow children to play with any radio equipment containing a transmitter.

DO NOT operate a transmitter near unshielded electrical blasting caps or in an explosive atmosphere unless it is a type especially qualified for such use.

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MOTOROLA

"STX" SERIES
"Handie-Talkie"
Trunked Portable Radios
806-825 MHz
851-870 MHz

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RELATED PUBLICATIONS AVAILABLE SEPARATELY

Operator's Manual - "Smartnet"	68P81049C90
Operator's Manual - "Privacy Plus"	68P81049C85
Service Manual	68P81049C80
N1352A "Converta-Com" Instruction Manual	68P81041C65
N1352A "Converta-Com" Operating Instructions	68P81041C95
N1353A Power Amplifier	68P81042C20
NTN1014A and NTN1012A 14-Hour Single Unit Chargers	68P81101C50
NTN1011A and NTN1013A Single Unit Rapid Chargers	68P81101C52
NTN4831A Multiple Unit Rapid Battery Charger	68P81101C69
NTN4832A Multiple Unit Slow Battery Charger	68P81101C71
NMF6001B Public Safety Microphone	68P81106C20
NMN6115B and NMN4339B Remote Speaker/Microphones	68P81106C23

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68P81049C75-O

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ACCESSORIES

MODEL	DESCRIPTION
N1352A	Converta-Com Console with 12-Watt Audio
N1353A	RF Amplifier, 15-Watt
NAF4000B	Dipole Antenna
NAF4050A	Whip Antenna
NLN4127A	Rack-Mount Kit for Multi-Unit Charger
NLN4128A	Wall-Mount Kit for Multi-Unit Charger
NLN6042A	Belt, Black
NMF6001B	Public Safety Microphone with Straight Coax Cord & Hook Pad
NMN4339B	Remote Speaker-Microphone with Coiled Cord and Clip
NMN6115B	Remote Speaker-Microphone with Straight Cord and Clip
NMN6130A	Remote Microphone with Earpiece
NTN1011A	Single-Unit Charger, Rapid Charge, 117 Volts
NTN1012A	Single-Unit Charger, 14-Hour, 117 Volts
NTN1013A	Single-Unit Charger, Rapid Charge, 230 Volts
NTN1014A	Single-Unit Charger, 14-Hour, 230 Volts
NTN4326A	Medium-Capacity Battery
NTN4327A	High-Capacity Battery
NTN4350A	Carry Holder
NTN4389A	Hold-Down Strap Nylon
NTN4390A	Swivel Case with Velcro for Medium-Capacity Battery
NTN4467A	Swivel Case with Velcro for High-Capacity Battery
NTN4490A	Carry Case Cover
NTN4500A	FM Approved High-Capacity Battery
NTN4534A	FM Approved Medium-Capacity Battery
NTN4664A	Surveillance Accessory
NTN4742A	Earpiece Adapter
NTN4831A	Multi-Unit Charger, Rapid Charge, 117/220 Volts
NTN4832A	Multi-Unit Charger, 14-Hour, 117/220 Volts

MODEL/OPTION CHART

MODEL NUMBER	DESCRIPTION
H25STC5170CN	1W SMARTNET DISPLAY
H25STD5170CN	1W SMARTNET BASIC ROTARY
H25STE5170CN	1W SMARTNET DISPLAY ROTARY
H25JNB5170CN	1W PRIVACY PLUS BASIC
H25JNC5170CN	1W PRIVACY PLUS DISPLAY
H35STC5170CN	3W SMARTNET DISPLAY
H35STD5170CN	3W SMARTNET BASIC ROTARY
H35STE5170CN	3W SMARTNET DISPLAY ROTARY
H35JNB5170CN	3W PRIVACY PLUS BASIC
H35JNC5170CN	3W PRIVACY PLUS DISPLAY

OPTIONS (ADD TO MODELS AT LEFT AS INDICATED BY A "•")	DESCRIPTION
H224	SUBSTITUTE MED. CAP. BATTERY FOR HI CAP. 3W
H226	HIGH CAPACITY BATTERY
H238	DYNAMIC REGROUPING
H239	DELETE EMERG./ADD VOLUME SET
H240	3-SYSTEM SELECT
H241	6-SYSTEM SELECT
H242	TEL INTERCONNECT WITH AUTO DIAL
H243	KEYPAD WITH DISPLAY
H269	16-SYSTEM SELECT
H270	25-SYSTEM SELECT
H271	8-POS. ROTARY SYSTEM SELECT
H272	16-POS. ROTARY SYSTEM SELECT
H274	FLEET/SUBFLEET SCAN
H280	4-SUBFLEET SELECT
H283	8-SUBFLEET SELECT
H288	15-SUBFLEET SELECT
H289	CALL ALERT DECODE
H290	PRIVATE CONVERSATION (1)
H291	PRIVATE CONVERSATION/CALL ALERT (8)
H292	MULTIPLE CALL ALERT ENCODE
H294	DELETE CONVENTIONAL CHANNEL
H297	TELEPHONE INTERCONNECT
H310	8-SYSTEM SELECT
H317	DELETE CASE
H628	15 SYSTEM SELECT/NO CONVENTIONAL
H753	FACTORY MUTUAL APPROVAL

ITEM NO.	DESCRIPTION
NAF4000B	ANTENNA, DIPOLE
NHN6371A	HOUSING KIT
NTN4326A	BATTERY, MED. CAPACITY
NTN4327A	BATTERY, HIGH CAPACITY
NTN4500A	BATTERY, HIGH CAPACITY FACTORY MUTUAL APPR
NTN4534A	BATTERY, MED. CAPACITY FACTORY MUTUAL APPR
NTN4335A	CONTROL TOP (NO ROTARY)
NTN4336A	CONTROL TOP & 2-POS ROTARY
NTN4337A	CONTROL TOP & 8-PCS ROTARY
NTN4338A	CONTROL TOP & 16-POS ROTARY
NTN4339A	FRONT COVER PARTS KIT, PLAIN
NTN4341A	FRONT COVER PARTS KIT, DISP & 3-BUTTON KEYPAD
NTN4342A	FRONT COVER PARTS KIT, DISP & 15-BUTTON KEYPAD
NTN4345A	KEYPAD
NTN4344A	MISC HARDWARE KIT (PLAIN)
NTN4347B	MISC HARDWARE KIT (STD ON/OFF VOL)
NTN4348B	MISC HARDWARE KIT (STD ON/OFF VOL & ROTARY)
NTN4401B	MISC HARDWARE KIT (SUBFLEET)
NTN4355A	ESCUTCHEON, 2 SUBFLEETS (A-B)
NTN4357A	ESCUTCHEON, PLAIN
NTN4358A	ESCUTCHEON, 8 SUBFLEETS (A-H)
NTN4360A	ESCUTCHEON, 1-8 CHANNELS/SYSTEMS
NTN4361A	ESCUTCHEON, 15 SUBFLEETS, 1 FLEET CALL (A-P)
NTN4363A	ESCUTCHEON, 1-16 CHANNELS/SYSTEMS
NTN4366A	ESCUTCHEON, 2 SYSTEMS/CHANNEL 1 & 2
NTN4384A	LABEL, EMERGENCY
NTN4385A	LABEL, TELEPHONE INTERCONNECT
NTN4386A	LABEL, VOLUME SET
NTN4402A	LABEL KIT
NTN4403A	LABEL KIT, FACTORY MUTUAL
NTN4498A	FRAME KIT WITH PTT
NTN4511A	FRONT SHIELD
NTN4519A	REAR SHIELD
NTN4769A	CIRCUIT BOARD, CONTROLLER
NUF6040C	CIRCUIT BOARD, RF, LOW POWER
NUF6050C	CIRCUIT BOARD, RF, HIGH POWER
	CONTROL PROGRAM (FIRMWARE) MODIFICATIONS
NTN4390A	SWIVEL CASE, VELCRO, FOR MED. CAPACITY BATTERY
NTN4467A	SWIVEL CASE, VELCRO, FOR HIGH CAPACITY BATTERY
NTN4389A	NYLON HOLD DOWN STRAP

KEY: X = INCLUDED **O = OMITTED** **• = OPTION AVAILABLE FOR INDICATED MODEL ONLY**

NOTES

DESCRIPTION

1. INTRODUCTION

The frequency-synthesized, trunked portable STX radio is an advanced design, microprocessor-based transceiver that uses hybrid modules and leadless components, reflecting the latest achievements in microelectronic technology. The computer circuitry controls the transmit and receive functions, monitors and displays radio status, and processes operator commands entered via the front cover keypad.

a. Physical Description

All operating controls, except the push-to-talk (PTT) switch (and the keypad on some models) are located on top of the radio. The PTT switch is located on the left side of the radio (viewed from the front), and the keypad (if so equipped) is an integral part of the front cover. All controls, including the PTT switch and the keypad, are weather resistant, and the microphone and speaker are covered with a diaphram for protection against adverse environmental conditions.

The height of the radio varies with the battery used. All other dimensions are standard, regardless of the model or options included. The functions provided in the STX radio are identified by the model number and the associated option number as illustrated in the model chart at the front of this manual.

Model number and associated option numbers for a radio will be displayed on the radio's customer information sheet which is shipped with the radio.

b. Electrical Description

The dual-conversion receiver utilizes ceramic stripline filters and hybrid modular technology to provide a 19MHz bandwidth. The entire i-f section and a quadrature detector is housed in a single hybrid module.

A phase-locked loop (PLL) frequency synthesizer generates an rf signal which is doubled and used for both receiver and transmitter injection. A ceramic filter in the injection filter/switch module passes the desired receiver or transmitter injection signal, while attenuating the fundamental frequency component of the VCO signal. A pin-diode switch in the injection filter/switch module determines whether the signal goes to the transmitter or receiver section.

The transmitter consists of an instantaneous deviation control (IDC) circuit, a PLL frequency synthesizer, a transmit buffer, and either a one-watt or three-watt power amplifier (PA). An automatic level control (ALC) circuit regulates the final stage current of the PA and the rf drive signal level from the previous stage, thus maintaining a constant power output over the entire frequency range. When a fully charged battery is installed, or the radio is installed in a "Converta-Com" console, the PA tends to put out more power, and consequently draw more current from the battery. The ALC limits the current, and thus, the output.

A separate controller circuit board contains a microprocessor, random access memory (RAM), read-only memory (ROM), an electrically erasable programmable read-only memory (EEPROM) and a gate array. The controller circuitry performs the following functions:

- Receives, interprets, and stores data.
- Controls channel frequency.
- Controls receiver squelch and transmitter modulation.
- Generates control and alert signals for radio operation.
- Communicates with the front cover and/or accessories via a serial bus.

A keypad/display assembly is an optional part of the front cover. It contains a slave microcomputer that accepts operator input data from the pushbutton keypad and outputs operator prompts and/or radio status to the display.

2. STANDARD FEATURES

The STX radio has an internal microphone and speaker, but can be operated with an external speaker and/or microphone. It can be operated as a hand-held portable or inserted into a vehicular "Converta-Com" console. An external antenna jack and a side connector are provided for "Converta-Com" operation, external accessories, and as a convenient means for testing the radio.

Two power output levels (one-watt and three-watts) are available, as well as a variety of optional features. The model chart at the front of this manual lists the available options and shows how they affect the kit structure of each radio model.

The battery pack slides onto the bottom of the radio and is held in place by a spring-loaded latch. Batteries are available in two different sizes; each can be charged at two different rates. The different size batteries affect the operating time between charges as well as the overall height and weight of the radio.

3. PRINTED CIRCUIT BOARDS AND FLEXIBLE CIRCUITS

a. General

Most of the functional circuits in the STX radio are contained in hybrid modules which are mounted on three rigid circuit boards: (1) the Transceiver Board, (2) the Controller Board, and (3) the Keypad/Display Board. Two flexible printed circuits (Control Flex and Interconnect Flex) eliminate all discrete wiring, except the antenna coaxial cable, the PTT interconnect, and the microphone and speaker wires, resulting in greater uniformity in construction.

b. Transceiver Board

The transceiver board is a six-layer printed circuit board containing all of the transmitter and receiver circuitry. All of the hybrid modules and leaded components are mounted on the top (module) side. The bottom layer (solder side) contains leadless components and can be exposed for testing.

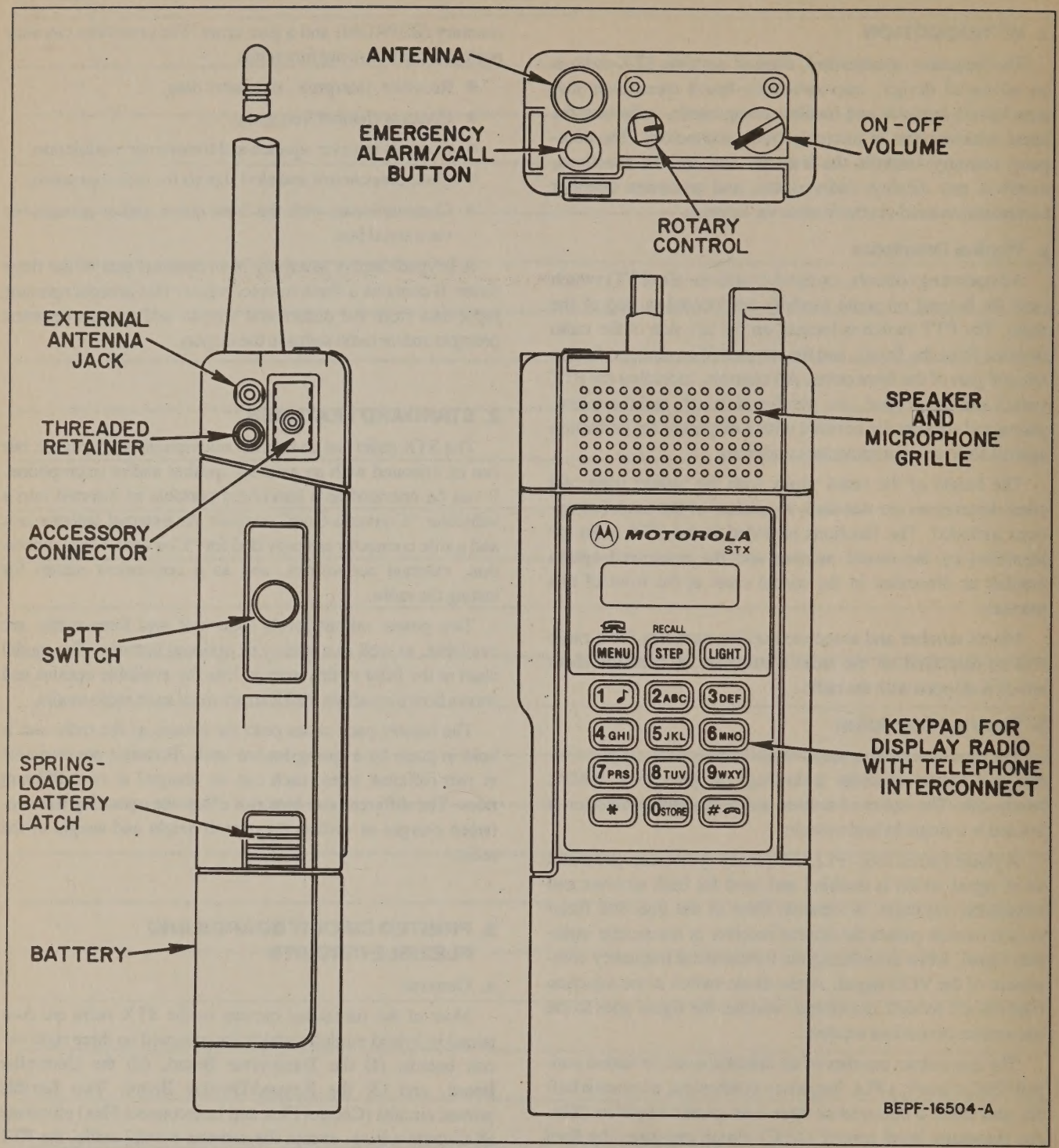


Figure 1. Typical STX Radio with Display and Keypad

c. Controller Board

The controller board is a four-layer printed circuit board containing CMOS and LSI circuitry in leadless chip carriers mounted on the top side of the board. Data and control signals are routed to the transceiver via edge contacts that mate with an edge connector mounted on the transceiver board.

d. Keypad/Display Board

The keypad/display board is a two-layer printed circuit board. It contains an LCD with LED backlighting, an 80-pin flat-pack slave microprocessor, and keypad switch contacts which are contacted by carbon-impregnated pads on the back of the keypad membrane. The slave microprocessor processes keypad information, sends data to the controller board, and passes controller status information to the display.

e. Interconnect Flex

The interconnect flex is a flexible printed circuit board that provides the power and data path between the controller board and the keypad/display assembly. One end of the interconnect flex is soldered to the controller board, and the other end contacts spring fingers on the keypad/display board (on radios so equipped).

f. Control Flex

The control flex is a flexible printed circuit board that interconnects all the top housing components. It is terminated in an edge connector which mates with the top edge of the transceiver board.

4. BATTERIES

The rechargeable nickel-cadmium batteries available for the STX radio are listed in Table 1. Battery choice is governed by duty cycle, operating time, and maximum height and weight desired.

Table 1.
Batteries for the STX Radio

MODEL NUMBER	BATTERY CAPACITY	MINIMUM CHARGE TIME	**TYPICAL HOURS OF OPERATION	
			1-WATT RADIOS	3-WATT RADIOS
NTN4326A	MEDIUM	2 HOURS	8 HOURS	***
*NTN4534A	MEDIUM	2 HOURS	8 HOURS	***
NTN4327A	HIGH	1 HOUR	12 HOURS	8 HOURS
*NTN4500A	HIGH	1 HOUR	12 HOURS	8 HOURS

* Factory Mutual approved batteries for intrinsically safe operation.
** Based on a duty cycle of 5% transmit, 5% receive, and 90% standby time.
*** Medium capacity batteries not recommended for 3-watt radios.

5. RADIO CARRY HOLDERS

The standard leather carry case supplied with the STX radio includes a swivel belt loop and nylon T-strap. When the radio is placed in the case, the nylon T-strap secures it by way of a velcro fastener. An optional carry holder with a belt loop is available (see your Motorola sales representative).

6. SPECIAL TERMS AND ABBREVIATIONS

The construction technology and circuits in the STX radio require the use of some special terms and abbreviations listed in the following table.

TERM	DESCRIPTION
ALC	Automatic Level Control
Alert Tones	Audible annunciators of radio status
ALR	Audio Logic Regulator
Code Plug	That portion of the software that is coded for the individual user
Controller Board	The printed circuit board containing the digital processing circuits and firmware command set
Control Flex	The flexible circuit which connects the top housing components to the transceiver board
CVC	"Converta-Com" Console (for STX vehicular operation)
DPL	"Digital Private-Line" (Digital Coded-Squelch)
DTMF	Dual-Tone, Multi-Frequency (Phone Interconnect Signalling)
HSD	High Speed Data signals used during channel acquisition
IDC	Instantaneous Deviation Control
LCD	Liquid Crystal Display
Logic 1	A voltage level of approximately 5Vdc
Logic 0	A voltage level of approximately 0Vdc
LSD	Low Speed Data signals which accompany voice modulation to maintain channel assignment
PA	Power Amplifier
PL	"Private-Line" (Tone Coded Squelch)
PLL	Phase Locked Loop
RPT/TA	Repeater/Talk-Around
RX	Receive
SCI	Serial Communications Interface
Fleet	A group of users partitioned from all other users within a trunked communication system
Transceiver Board	The printed circuit board containing the functional components of the receiver and transmitter
TRK/CONV	Trunked/Conventional
Trunked	Automatic sharing of a small number of communication paths (channels or "trunks") among a relatively large number of users
TX	Transmit
VCO	Voltage Controlled Oscillator
Subfleet	Conversation groups within a fleet
System	A collection of equipment working on the same group of frequencies

BATTERY CHARGING

1. CHARGERS AVAILABLE

Available chargers include single-unit desk top chargers and multiple-unit chargers that may be mounted on a wall or bench. The multiple-unit chargers will charge up to six nickel-cadmium batteries at one time.

NOTE

The batteries are shipped in a discharged state. Charge before using.

The chargers are available in slow charge and rapid charge models. The slow charge models will charge any of the batteries, with or without the radio attached, in 14 hours. The rapid charge models will charge the high-capacity batteries in one hour, and the medium capacity batteries in two hours. Refer to Table 2.

Table 2.
Charging Time for Typical Charger/Battery Combinations

BATTERY	CHARGERS	
	SLOW	RAPID
MODEL	NTN1014A NTN1012A NTN4832A	NTN1012A NTN1011A NTN4831A
NTN4326A	14 Hours	2 Hours
NTN4327A	14 Hours	1 Hour
NTN4500A	14 Hours	1 Hour
NTN4534A	14 Hours	2 Hours

There are four single-unit desk top chargers available. Two models operate from a 115Vac power source and two models operate from a 230Vac power source. Two multiple-unit chargers are available. Both of these chargers have a switch for selecting 115Vac or 230Vac operation.

2. BATTERY CONSTRUCTION (See Figure 2)

The STX battery has four charger contacts, two of which receive the charging current. A third contact connects an internal resistor (R_R) to the charger, automatically setting the charging current output to match the capacity of the battery. The fourth contact connects an internal thermistor to the charger. The thermistor senses battery temperature and automatically controls the charger output to permit maximum charger output without overheating the battery.

All rapid charge batteries contain an internal fuse for protection. A diode in the battery prevents damage from an accidental short between the charging contacts.

CAUTION

Sustained shorts across the radio contacts (+, −), excessive current, or excessive heat will destroy the internal thermal fuse, which is not replaceable.

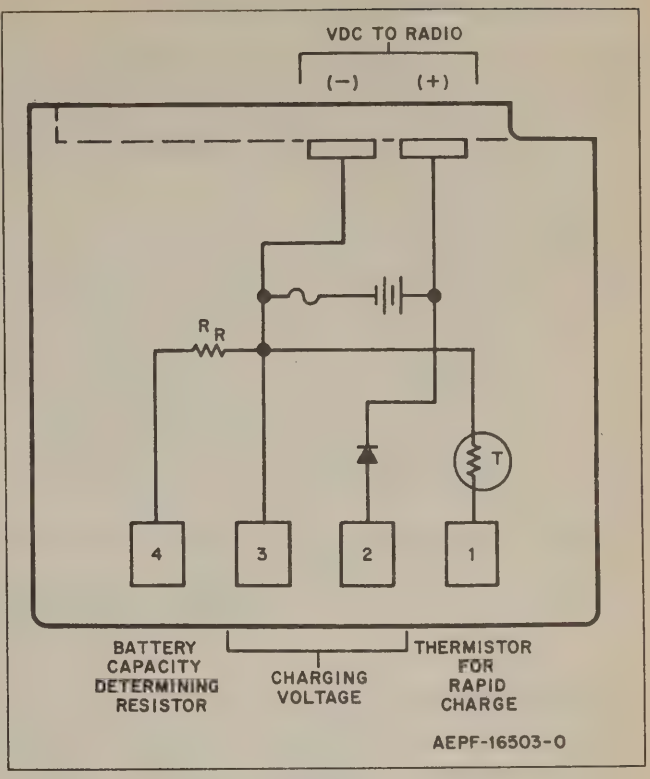


Figure 2.
Typical Battery Construction, Rear View

3. BATTERY CHARACTERISTICS

Each nickel-cadmium battery consists of six cells connected in series to provide a nominal 7.5Vdc output, which remains approximately constant under load until the battery approaches the discharge condition. At this time, a marked decrease in voltage occurs and the discharge condition (1.0 volt per cell) is reached abruptly.

A general characteristic of all rechargeable batteries in storage is self discharge. If the battery is to be used after an unknown period of storage, it is recommended that it be charged at the full charging rate using an approved battery charger.

4. MAINTENANCE

The battery cells will never require additional electrolyte. The only maintenance required is recharging the battery and keeping the contacts clean. Use only a Motorola approved charger. The use of other chargers, unless approved, will void the battery warranty and may result in permanent damage to the battery. Follow the charging instructions which accompany the charger. For more complete information, refer to battery charger information sheet.

5. STORAGE

The battery may be stored at room temperature in any state of charge without damage. As previously stated, however, the battery is subject to self discharge and should be recharged after extended storage.

6. DETERMINING BATTERY CAPACITY

Battery capacity is determined by measuring the time that a fully-charged battery requires to discharge to six volts through a specified load, as described in the following procedure. A six-unit capacity tester (part no. NTN4831A and NTN4832A) is available from Motorola.

a. Medium Capacity Batteries (NTN4326A and NTN4534A)

Step 1. Connect a 8.9-ohm, 1%, 10-watt resistor across the two terminals on top of the battery and discharge the battery to six volts. **CAUTION:** Discharging the battery below 3.0 volts may cause cell reversal and permanently damage the battery.

Step 2. Charge the battery fully, using an approved Motorola charger.

Step 3. Discharge the battery through the resistor used in Step 1 until the terminal voltage reaches six volts. Check the time required (from the time that the resistor is connected). If a battery is defective, it will discharge in less than 48 minutes.

Step 4. Remove the resistor load from across the terminals.

b. High Capacity Batteries (NTN4327A and NTN4500A)

The procedure for checking the high capacity batteries is identical to the procedure for medium capacity batteries described in the preceding paragraph, except that a 6.0-ohm, 1%, 15-watt resistor load is used to discharge the battery.

THEORY OF OPERATION

1. INTRODUCTION

This section of the manual provides a basic and a detailed functional description of the STX radio and its components. Overall functions are discussed first in general terms with each circuit and its relationship to other parts of the radio described. Detailed circuit descriptions are then given for each board, circuit, and module used in the radio.

2. BASIC FUNCTIONAL DESCRIPTION

a. DC Voltage Distribution

Operating power for the radio is derived from a 7.5Vdc battery and when the radio is turned on, the voltage sources required to operate the various stages of the radio are distributed as shown in Figure 3. In the transmit mode (PTT actuated), the PRE-TX ENABLE signal from the controller enables the switching circuits to provide the required 7.5Vdc and 4.4Vdc to the transmitter circuits.

Voltage regulator U8, in addition to providing the required regulated dc voltages (5.0 and 4.6), also contains a lock detector which gives a "lock" indication when the synthesizer is locked on frequency.

b. Frequency Generation and Distribution Circuits (See Figure 4)

The frequency generation and distribution circuits in the STX radio are common to both the receiver and the transmitter. They provide the carrier frequency for the transmitter and the injection signal for the receiver first mixer stage.

(1) Frequency Generation

The frequency generation circuits include reference oscillator U10, synthesizer U11, and VCO U12. The reference oscillator generates a 12.8MHz reference signal for the synthesizer. An external adjustment is provided to set the output frequency of the reference oscillator.

Initially, the VCO becomes active and generates a signal, part of which is coupled back as an injection signal to the synthesizer. The synthesizer divides and compares this to its reference frequency and generates an error signal which causes the VCO to change frequency. When the VCO reaches a frequency that causes a zero-degree phase comparison with the PLL reference frequency, the synthesizer generates a constant control voltage, locking the VCO on frequency.

(2) Frequency Multiplier Circuit

The frequency multiplier circuit (U102) doubles the 403-435MHz signal from the VCO to 806-870MHz, and couples the signal to the injection filter/switch module (U103).

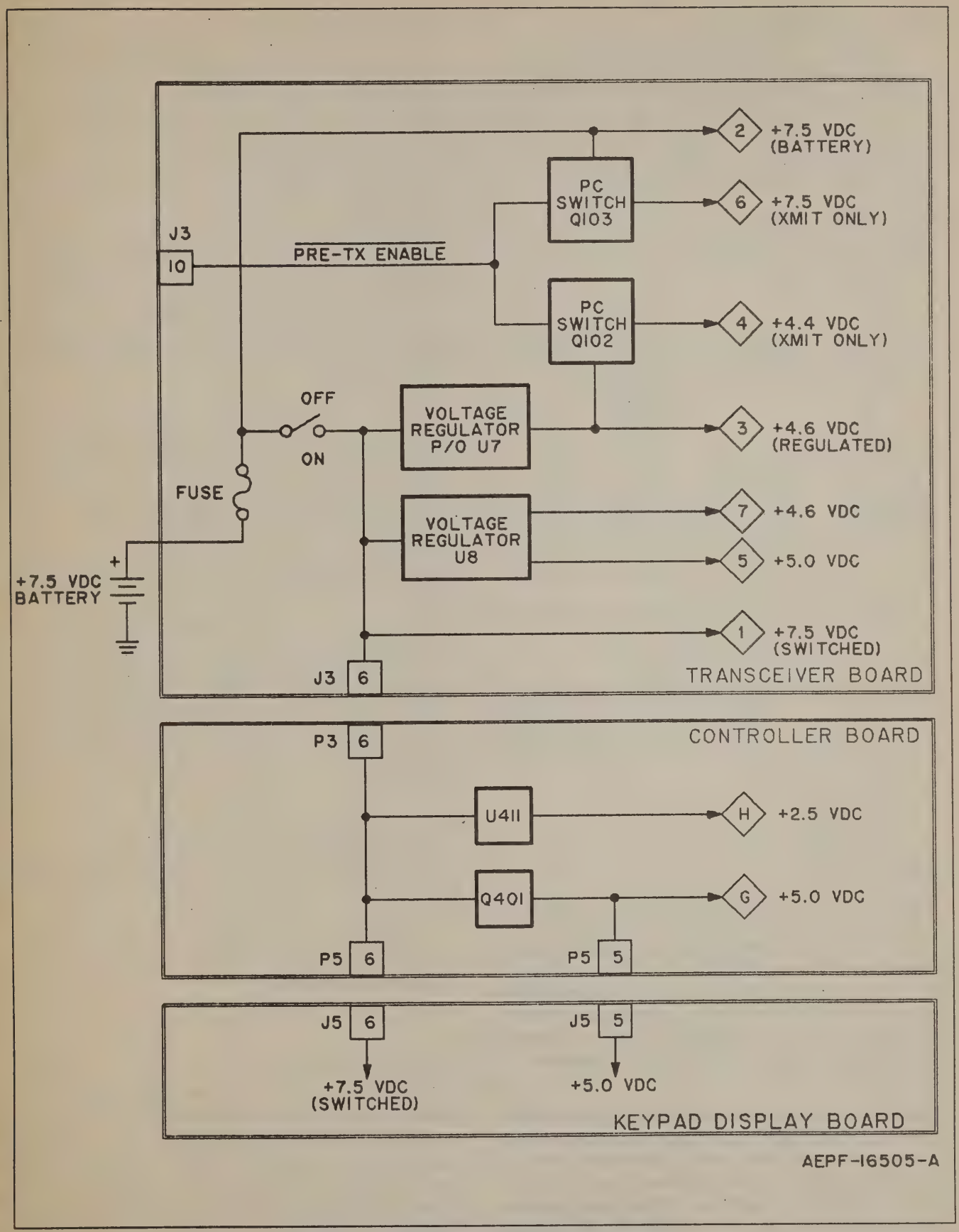


Figure 3. DC Voltage Distribution Block Diagram

(3)Injection Filter/Switch Circuit

The injection filter/switch performs three functions: (1) the microstrip filter passes the 806-870MHz signal and rejects the fundamental 403-435MHz and all other harmonics; (2) a pin diode switch directs the signal to either the receiver first mixer or to the transmit buffer, depending on the mode of operation; and (3) two attenuator pads set the level of the rf signal by providing attenuation of the signal to the transmitter, and to the receiver.

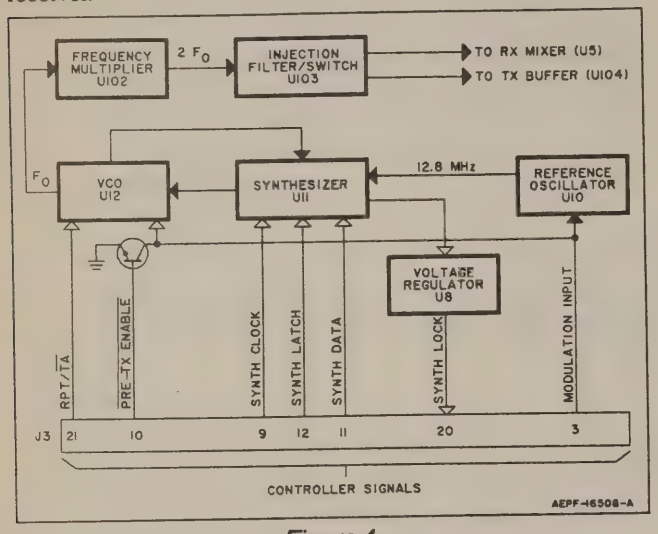


Figure 4.
Frequency Generation and Distribution Circuits Block Diagram

c. Basic Receiver Operation (See Figure 5)

STX radios use double-conversion superheterodyne receiver circuits to provide greater image-signal suppression and improved adjacent channel selectivity. The receiver consists of three main sections:

- radio frequency (rf) circuits
- intermediate frequency (i-f) circuits
- audio frequency (af) circuits

(1) RF Signal Path

The rf signal is received by the antenna and coupled to bandpass filter U2 through the antenna switch (U1). The output signal from the first bandpass filter is amplified by rf preamplifier U3. The amplified signal is then coupled through a second bandpass filter (U4), and applied to the rf input of the first mixer stage (U5). An injection signal is applied to the second input of the mixer, resulting in an output difference frequency of 44.9625MHz, which is the first i-f frequency.

(2)I-F Signal Path

The first i-f signal is passed through a highly selective crystal filter (FL001) to circuit module U6, where it is mixed with a second oscillator injection signal to produce the second i-f frequency of 455kHz. The low conversion signal is then filtered, amplified, and demodulated. The recovered audio is routed to the ALR module U7. Module U6 also contains voltage regulation and squelch detection circuits.

(3)Audio Signal Path

Recovered audio from U6 is passed directly to the audio preamplifier circuit in U7. The output from the preamplifier stage is connected through the volume control to the audio driver stage in U7. Audio output from U7 is used to drive the audio amplifiers (Q201-Q003) and (Q202-Q004) which, in turn, drive the internal speaker. If an external speaker is connected to the CVC connector, switch S602 is opened and the internal speaker is disconnected.

The squelch circuits in U6 detect discriminator signal-to-noise ratio and produce a dc logic signal output. For carrier squelch operation, when no carrier signal is present the output is a high NOISE SQUELCH signal and is routed to the controller. The controller then outputs a high $\overline{\text{RX ENABLE}}$ signal to the squelch logic in U7 which disables the audio preamplifier section and prevents any audio signal to the volume control and hence the speaker.

When a signal above the squelch threshold is received, U6 produces a low NOISE SQUELCH to the controller. The controller then outputs a low $\overline{\text{RX ENABLE}}$ signal which enables audio to the speaker. The controller also monitors the IF DISCRIMINATOR signal from the audio output of U6, and the preamplifier in U7 is turned on ($\overline{\text{RX ENABLE}}$ low), provided any received codes match the operating mode of the radio, e.g., Connect Tone (Trunking Voice Channel), proper PL tone or proper DPL code, audio will be enabled to the speaker.

The audio driver in U7 is also affected by logic signals. When alert tones are generated, the controller sets the $\overline{\text{RX ENABLE}}$ and SPEAKER ENABLE lines high, causing the audio preamplifier to block any received signal and enable the audio driver to pass the alert tones through to the speaker. In the transmit mode, the SPEAKER ENABLE signal from the controller is low, preventing any audio signal from reaching the speaker.

d. Basic Transmitter Operation (See Figure 6)

The transmitter (excluding the frequency generation and distribution circuits described in paragraph b) comprises four main circuits:

- Instantaneous Deviation Control
- Transmit Buffer
- RF Power Amplifier
- Automatic Level Control

(1) Audio Signal Path

When the PTT switch is pressed, audio from the microphone is applied to the instantaneous deviation control (IDC) module (U101), which amplifies, shapes, limits, and filters the audio signal. The processed audio signal from the IDC is then routed through the controller where it is superimposed with the proper data for PL, DPL or trunked operation, then routed to the VCO and reference oscillator, where carrier modulation is achieved.

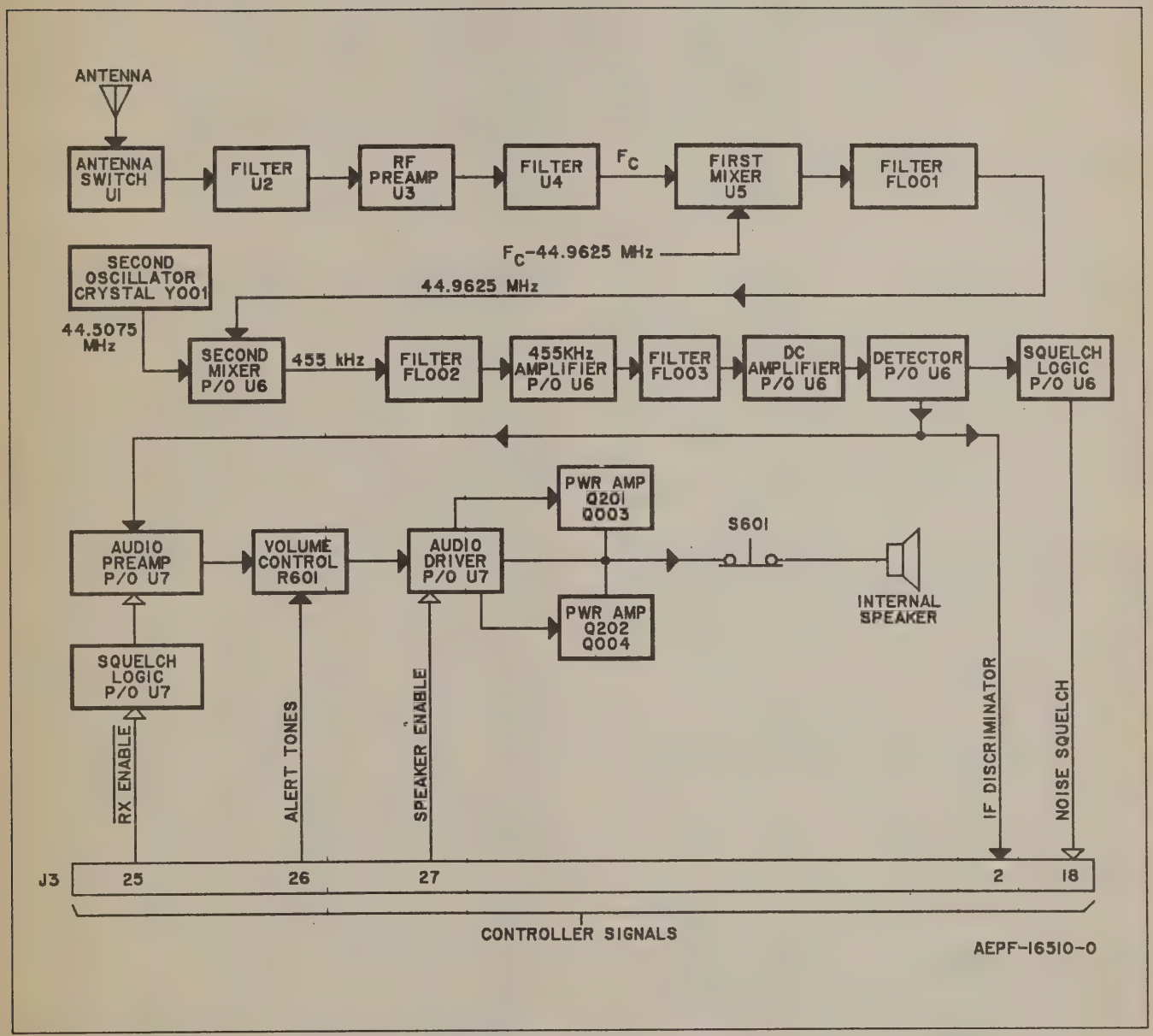


Figure 5. Receiver Block Diagram

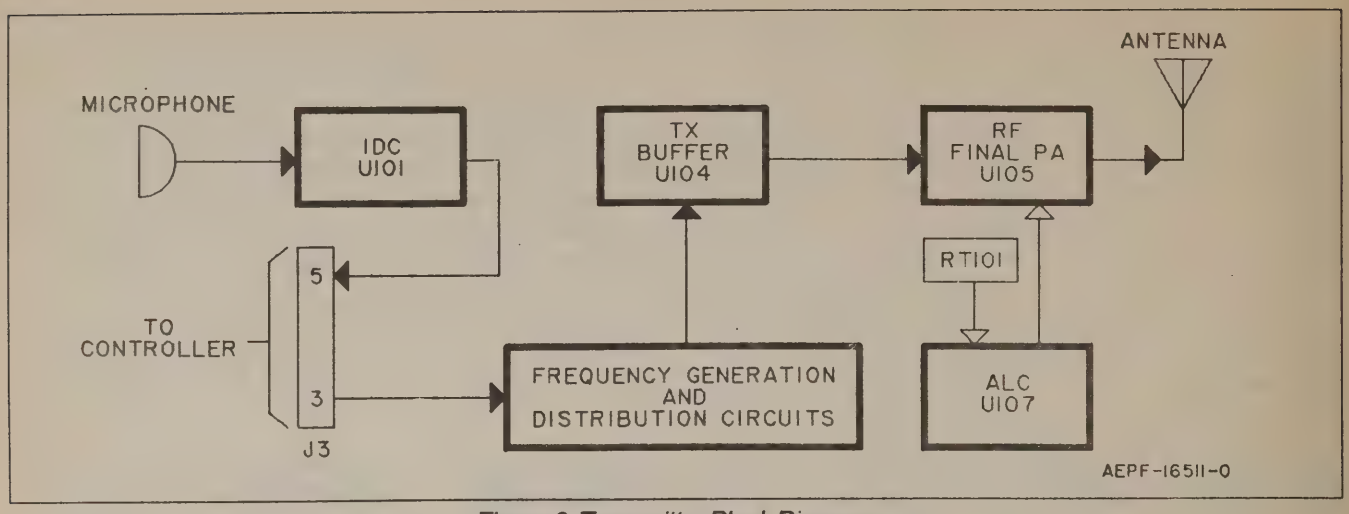


Figure 6. Transmitter Block Diagram

(2)Modulated RF Signal Path

The modulated rf carrier signal is applied to the transmit buffer (U104), where it is amplified and then limited to maintain a constant output level into the rf final power amplifier (U105). The rf final amplifier circuit amplifies the modulated carrier signal sufficiently to provide either a one-watt or a three-watt signal (depending on the radio model) to the antenna, through the antenna switch module, U1.

(3)Automatic Leveling Control (ALC) Circuit

The primary function of the ALC circuit (U107) is to maintain a constant output power over variations in frequency and battery voltage. If the power amplifier generates excessive heat, a thermistor (RT101) located near the module senses the temperature change and causes the ALC to reduce the output from the rf final amplifier.

e. Basic Controller Functions (See Figure 7)

The controller circuit board contains the following components, which form the main microprocessor system:

- U401 – Gate Array
- U402 – Microprocessor
- U403 – Random Access Memory (RAM)
- U404 – Erasable Programmable Read Only Memory (EPROM)
- U405 – Electrically Erasable Programmable ROM (EEPROM)
- Y401 – Crystal (System Clock)

The ROM contains a set of programmed instructions that are executed by the microprocessor. These instructions direct the microprocessor to generate various control signals and addresses which, in turn, establish control and communication paths between the other components of the system. Complete system data for the radio is stored in the EEPROM. The RAM provides fast temporary storage. The gate array performs most of the necessary digital interfacing functions among the microprocessor, the rest of the controller circuit board, and other sections of the radio. All digital interfacing functions not performed by the gate array are performed by the microprocessor.

In addition to the main microprocessor system, the controller circuit board contains high-speed and low-speed data filters, op-amps, comparators, analog gates, analog switches, and discrete components which are used to shape, control, and route data and audio signals. This circuitry, represented by the "Signal Switching Circuits" block in Figure 7, is described later in paragraph 3 (DETAILED CIRCUIT DESCRIPTIONS) of this section of the manual.

(1) Self Test

When the radio is first turned on, the microprocessor executes a sequence of instructions that tests most of the digital functions on the controller board, including RAM, ROM, EEPROM, and a portion of the gate array. If any of the tested circuitry is not functioning properly, various sequences of two possible audio tones are generated by the microprocessor, depending on what circuitry failed. The two audio tones are: (1) a high tone called "volume set," and (2) a low tone called "illegal mode." The radio is then shut down completely and, if the radio is equipped with a display, all of the segments of the display will light up to indicate a malfunction. An explanation of these tone sequences is found in Table 21.

(2)Address and Data Bus Structure

A microprocessor address consists of 16 bits, with the low-order bits (0 through 7) output on the AD0-AD7 common address/data bus lines and the high-order bits (8 through 15) placed on the A8-A15 address bus lines. When an address is generated, the AS line is pulled high causing the gate array to latch the address from the AD0-AD7 bus, freeing these lines for use as a data bus. The latched lower half of the address is then placed on the A0-A7 bus to access information stored in the RAM, ROM, and EEPROM or to store information in the RAM.

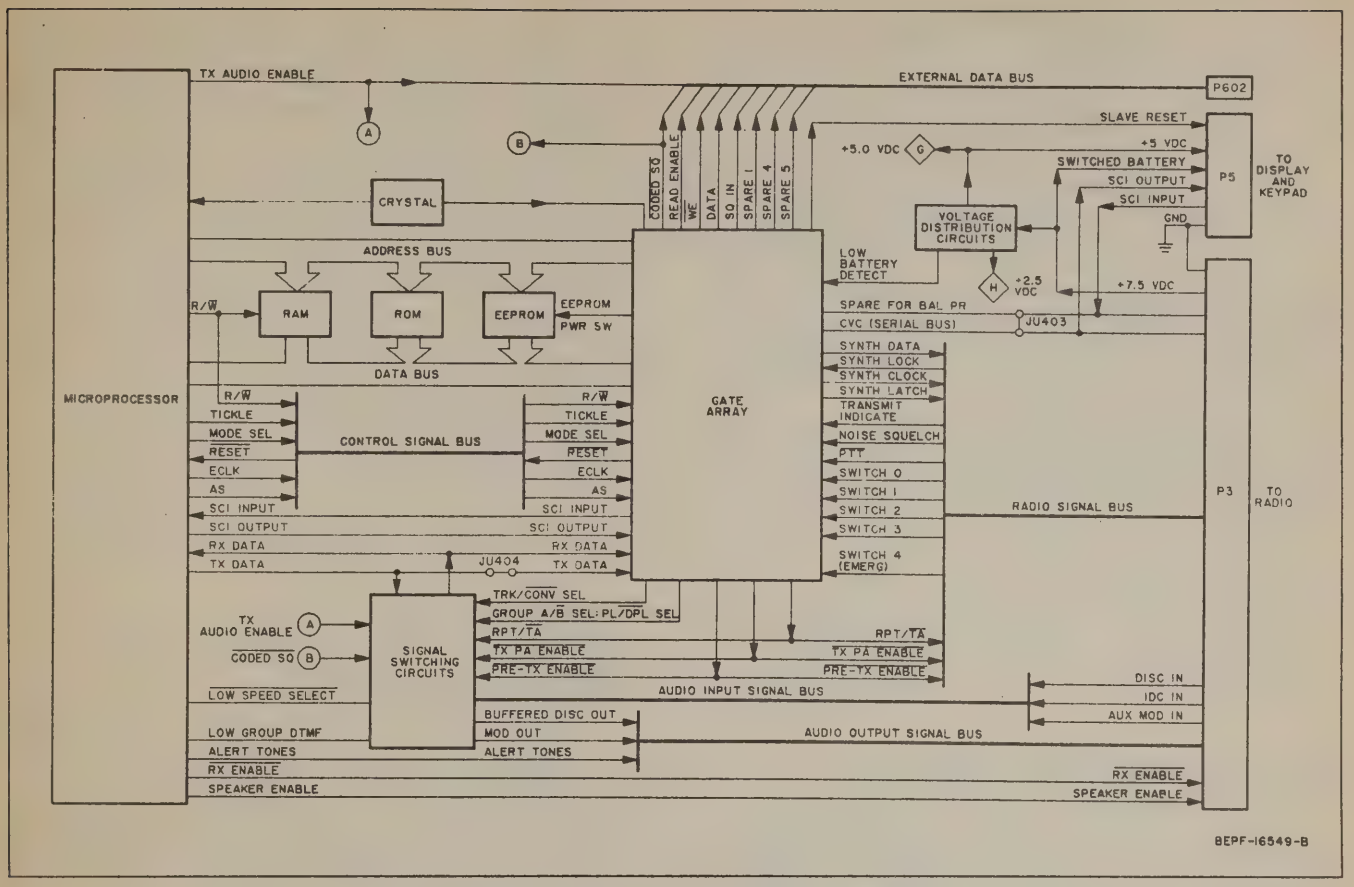


Figure 7. Controller Functional Block Diagram

(3) System Generated Control Signals

The following signals control the transfer of data and provide the necessary switching and status information for proper operation of the on-board gate array and signal switching circuits:

- AS (Address Strobe) – Indicates to the gate array module that the microprocessor has placed an address on the data bus.
- $\overline{\text{CODED SQ}}$ – Selects an impedance path to reduce the microphone audio signal in a PL, DPL, or trunked system where there is subaudible squelch information.
- ECLK – Enable clock of processor.
- EEPROM PWR SWITCH – When low, allows access to information stored in the EEPROM by gating power via a transistor switch.
- GROUP A/B SEL or PL/$\overline{\text{DPL}}$ SEL – Controls two switches. One switch selects the proper impedance path for a PL or DPL signal. The other switch selects the proper impedance path for a low group DTMF signal.
- LOW BATTERY DETECT – If the battery voltage has dropped to approximately 6.4Vdc, this signal causes an audible chirp from the speaker and, if the radio is equipped with a display, a visual low-battery indication.
- $\overline{\text{LOW SPEED SELECT}}$ – Causes low-speed or high-speed data to be switched through appropriate filtering circuit(s).
- MODE SEL – A logic high tri-states outputs of gate array U401. A logic low allows normal I/O operation.
- $\overline{\text{OE}}$ E^2P (Output Enable) – When low, enables the EEPROM to send data to the microprocessor.
- $\overline{\text{OE}}$ RAM (Output Enable) – When low, enables the RAM to send data to the microprocessor.
- $\overline{\text{OE}}$ ROM (Output Enable) – When low, enables the ROM to send data to the microprocessor.
- $\overline{\text{PRE-TX ENABLE}}$ – Prevents received audio from reaching the audio amplifier stages and initiates the transmit cycle (see Radio I/O Signals).
- R/$\overline{\text{W}}$ (Read or Write) – The R/W line from the microprocessor to the RAM and gate array modules goes low to allow the microprocessor to write to the modules. A high indicates a read.
- RPT/$\overline{\text{TA}}$ (Repeater or Talk Around) – Selects the proper impedance path for the IDC audio signal and subaudible tones or codes. Also shifts the VCO frequency.

- $\overline{\text{RESET}}$ – A logic low level causes the processor to start from the beginning state.

- TICKLE – All digital operations on the controller board depend on the application of this pulse to the gate array from the microprocessor. If this pulse is not present, the microprocessor is reset and the radio is non-functional.
- TRANSMIT AUDIO ENABLE – Sets an analog switch to provide a signal path for microphone audio.
- $\overline{\text{TX PA ENABLE}}$ – Enables the final transmit amplifier stage on the controller board, and turns on the rf final PA (See Radio I/O Signals).
- TRK/$\overline{\text{CONV}}$ SEL (Trunked or Conventional) – When high, this signal selects an impedance path of the required value for trunking.
- $\overline{\text{WE}}$ E^2P (Write Enable) – When low, enables writing to the EEPROM.
- XTAL (Crystal) – Provides the fundamental clock reference for instruction execution and memory access cycles.

(4)Radio Input/Output (I/O) Control Signals

The radio I/O control lines are the communications link between the controller board and the transceiver board. The output signals, which originate on the controller board control the radio functions and establish the proper audio and data paths, based on the status of the input signals generated by the transceiver board.

- $\overline{\text{PRE-TX ENABLE}}$ – Initializes the transmitter circuitry on the rf circuit board.
- $\overline{\text{PTT}}$ – Signals the microprocessor that the push-to-talk button has been depressed and the transmitter circuitry should be powered up.
- $\overline{\text{RX ENABLE}}$ – Unsquelches the radio by allowing the received signal to be applied to the audio preamplifier stage.
- RPT/$\overline{\text{TA}}$ – Switches the VCO frequency such that the radio operates in either the repeater or talk-around mode.
- SLAVE RESET – Resets the display. During initialization, the display is reset. During normal operation, if the display does not respond, the display is reset.
- SPEAKER ENABLE – Enables the audio driver stage of the receiver.
- SWITCH 0 Through 3 – These lines come from the rotary switch; on top of the radio. When a position is selected, the particular lines switch either high or low to set up the appropriate binary level, providing a hexadecimal number from 0 to F (decimal 15). Depending on the radio, the rotary switch provides either subfleet or system selection.
- SWITCH 4 (EMERG) – The SWITCH 4 line is hardwired to the control key on top of the radio. Depending on the radio, this switch can be used for emergency, phone, or volume set.
- SYNTH CLOCK – Clocks the data bits into the synthesizer serially, when frequency data is present.
- SYNTH DATA – Feeds frequency data to the synthesizer, when a new frequency is loaded.
- SYNTH LATCH – Latches the frequency data, when it is loaded.
- SYNTH LOCK – Indicates to the controller that the synthesizer has stabilized or locked on a specified reference frequency.
- TRANSMIT INDICATE – Informs the controller that the transmitter circuitry has powered up and is stable.
- $\overline{\text{TX PA ENABLE}}$ – Turns on the radio rf final PA.

(5)Audio and Data Signal Paths

- ALERT TONES – Any one of several alert tones (frequencies) are generated by the microprocessor and sent to the audio driver for different situations, such as a keypad closure or when another radio is attempting to make contact. Refer to Operating Instructions for explanation of alert tones.
- BUFFERED DISC OUT – Received audio (DISC IN) is amplified, buffered and then routed to the CVC connector via this line.
- CVC (SERIAL BUS) – See SCI INPUT and SCI OUTPUT
- DISC IN – Received audio from the transceiver board discriminator circuit is injected on this line to the controller for processing.
- IDC IN – Processed microphone audio is routed to the controller via this line.
- LOW GROUP DTMF – This audio line carries the lower of a pair of tones generated by the microprocessor in response to a front cover key depression. The specific frequency of the tone identifies the keypad row number. The second (higher) tone of the pair is generated on the TX DATA line, and identifies the keypad column number. The frequencies of the two signals combined identify the depressed key. DTMF is used for phone signalling.
- MOD OUT – Microphone audio and microprocessor generated tones and data are present on this line for modulation of the rf carrier.
- RX DATA – Received data from the rf board is processed on the controller board and input to the microprocessor on the RX DATA line. Based on the information being received, the microprocessor then reacts accordingly.

- SCI INPUT and SCI OUTPUT – The controller communicates with the display microprocessor via the Serial Communications Interface input and output lines, which are tied together on the controller board to form the CVC (SERIAL BUS). The controller microprocessor generates information such as display characters and sends the data to the display microprocessor via the SCI OUTPUT line. The display microprocessor returns keypad closure information via the SCI INPUT line. These lines are also used for programming the EEPROM.
- TX DATA – The microprocessor-generated data signals are sent out on the TX DATA line, processed by the controller circuitry, and routed to the transceiver board where the digital information is modulated with the rf carrier.

f. Front Cover Assembly Functions (See Figure 8)

The front cover assembly is one of the user's primary means of controlling the STX radio. It consists of a keypad/display board, and optional LCD. The keypad allows the user to input commands or information to the radio. The LCD, if the radio has one, provides visual feedback.

When a key is pressed, the microcomputer decodes the row and column information, converts it to a serial data format, and sends the data to the controller via the SCI IN line. The controller interprets the serial data and makes the appropriate response. There could be multiple responses to a single key depression, such as a display update, acknowledgement, etc. The controller's response is in the same serial format, and is sent back to the display microcomputer via the SCI OUT line. The display microcomputer decodes the response and acts appropriately, e.g., updates the display.

The following definitions identify the meaning of the various display indicators and pushbutton keys, but not necessarily all of the conditions under which they are displayed or used. Refer to the STX Radio User's Guide for a complete functional description of operational modes and annunciator usage.

(1) Display Annunciators (Indicators)

- ALERT – Indicates that the Call Alert function is selected or, when flashing, that a Call Alert page was transmitted or received.
- BATT (Low Battery) – Indicates that the radio battery should be charged or replaced.
- LCK (Keypad Lock) – Indicates that the Keypad Lock function is selected. A flashing indicator means that the keypad is unlocked.
- PVT (Private Conversation) – Lights when the Private Conversation mode is selected. This annunciator flashes when the PVT function is not selected and a Private Conversation message is received.
- SCN (Trunking Scan) – Indicates that preselected subfleets are being monitored.
- SUB (Subfleet) – Indicates the subfleet mode is selected.
- SYS (System) – Indicates the system mode is selected. Systems can be trunking systems, fleets, or conventional frequencies.
- ↟ (Transmit) – Indicates that the radio is transmitting.

(2) Display Function Keys

- MENU – Steps through and selects various radio functions.
- STEP – Selects the values of the functions chosen with MENU.
- LIGHT – Illuminates the display for 15 seconds after the last key has been depressed.

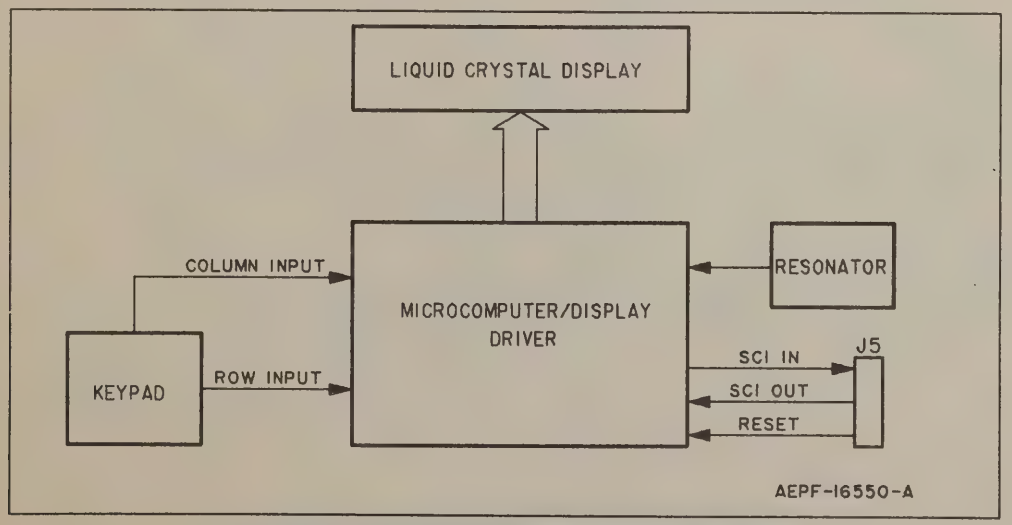


Figure 8. Front Cover Assembly Block Diagram

3. DETAILED CIRCUIT DESCRIPTIONS

The circuit descriptions contained in the following paragraphs are supplemented with simplified partial schematic diagrams to help the service technician understand the signal processing in the various stages of the radio. They are not intended for troubleshooting or servicing. Refer to the complete schematic diagrams in the service manual when repairing the radio.

a. Frequency Generation and Distribution (See Figure 9)

Reference oscillator U10 contains a crystal-controlled oscillator and two varactor diodes, which affect the nominal oscillator frequency of 12.8MHz. An external ten-turn potentiometer, connected to pin 7 of U10, is adjusted to set the voltage of one varactor and, in turn, the frequency of the oscillator.

A modulation signal (low frequency content) from the controller is applied to the varactor diode via pin 12 of U10. This voltage across the varactor produces modulation of the transmitter carrier frequency. The output from reference oscillator U10 (pin 2) is coupled to the divider section of synthesizer U11 (pin 6).

The circuitry on the controller board decodes the position of the rotary switch or a keypad entry and the status of the PTT switch to properly access the binary information stored in an electrically eraseable programmable read-only memory (EEPROM). This information and the decoded control channel information are processed by the controller and then a binary data pattern corresponding to the proper carrier frequency is loaded into the programmable dividers in the synthesizer.

The synthesizer module contains a high-frequency prescaler, a phase comparator, a set of programmable dividers, and a charge pump circuit, followed by a loop filter. A feedback signal from the VCO (U12) is divided by the high-frequency prescaler and the ÷N programmable divider, and applied to the phase comparator. The 12.8MHz reference oscillator signal is divided by the ÷M divider, and is also applied to the phase comparator. The difference frequency from the phase comparator is filtered by the loop filter to provide a dc control voltage to the VCO module.

If the feedback and reference frequencies are not the same, the phase comparator circuit causes the VCO to shift towards the desired frequency by changing the dc control voltage. Once the frequencies are identical, phase lock occurs, and this

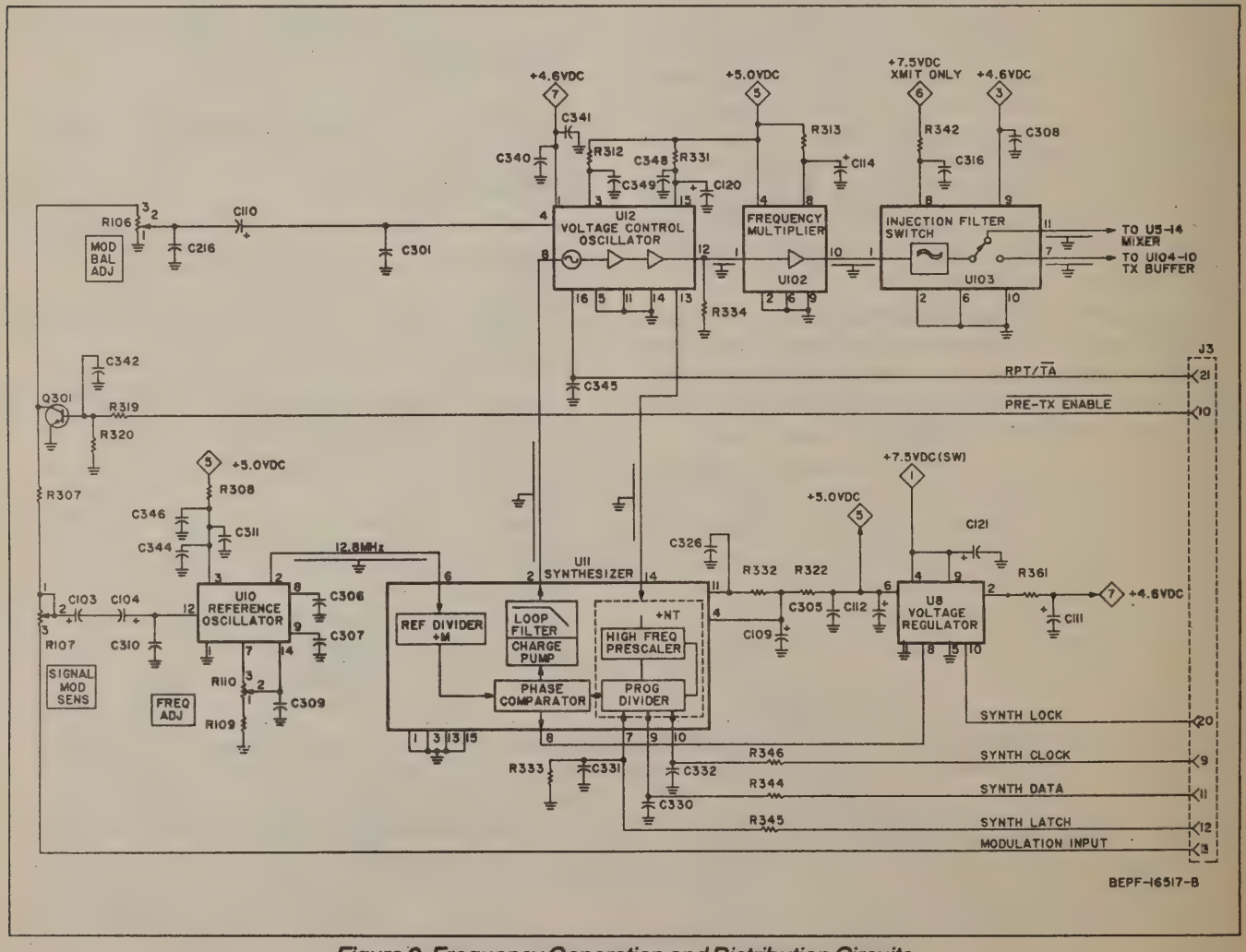


Figure 9. Frequency Generation and Distribution Circuits

information is provided to the controller via the voltage regulator module (U8). A logic high from the lock detector circuit informs the controller to enable the final rf amplifier. A logic low prevents the transmitter from generating power.

The VCO module contains a basic oscillator which is varactor tuned and modulated. The control voltage (one to four volts dc) from the synthesizer module is connected to pin 8 and applied across a tuning varactor diode. The level of the control voltage determines the capacitance of the varactor, and thus the frequency of the oscillator.

Pin 4 of the VCO is the modulation port. In the transmit mode, modulation signals from the controller are applied to the modulation varactor (via pin 4), which is in parallel with the tuning varactor. The modulation signal varies the capacitance of the varactor, and thus varies the oscillator frequency, causing transmitter carrier signal deviation.

The VCO is a dual-range oscillator (403-412.5MHz or 425.5-435MHz). The low frequency range is selected when the RPT/$\overline{TA}$ signal from the controller is high, and the high frequency range is selected when a low RPT/$\overline{TA}$ signal is applied to pin 16 of U12.

When the STX radio is operated through a repeater, pin 16 of the VCO is held high during both transmit and receive modes, thereby setting the transmit frequency approximately 45MHz below the receive frequency. For direct portable-to-portable (talk-around) operation, the transmitter and receiver must operate on the same frequency; therefore, pin 16 of U12 is pulled low in the transmit mode to select the high range, bringing the transmit frequency up to the receive frequency.

Two buffer amplifiers in the VCO module provide a constant output level as well as isolation. The VCO output is doubled to the 800MHz range by the frequency multiplier module (U102) before it is passed to the injection filter/switch module (U103).

The injection filter/switch module filters the 806-870MHz signal from the frequency multiplier and switches the signal to either the receiver mixer or the transmit buffer, depending on the mode of operation.

The rf input signal (pin 1 of U103) is applied to a two-pole ceramic microstrip filter which passes signals in the 806-870MHz frequency range, but rejects the 403-435MHz fundamental frequency component. The filtered signal is then applied to a pin diode switch that determines the routing of the signal. Switching is accomplished by applying or removing 7.5Vdc at pin 8 to either forward or reverse bias each of the two diodes.

In the receive mode, pin 8 of U103 is at ground potential, causing the signal to be directed to the receive port (pin 11). Electrically, the transmit port is an open circuit. In the transmit mode, 7.5Vdc is applied to pin 8, directing the signal to the transmit port (pin 7), and providing an open circuit condition at the receive port.

b. Receiver RF and First I-F Stages (See Figure 10)

In the receive mode of operation, pin 6 of antenna switch module U1 is at ground potential. This condition causes the antenna port (pin 5) to be electrically connected to the receive port (pin 8), allowing the signal from the antenna to be coupled through to the filter module (U2).

Filter module U2 contains a two-pole stripline filter that provides the desired selectivity and image rejection. The filter passes the receiver frequency range (851-870MHz) and provides image rejection.

RF preamplifier U3 contains a small signal amplifier designed for operation in the 851 to 870MHz frequency range, with a nominal three dB noise figure and 11dB gain. In the transmit mode of operation, transistor Q203 is turned off by the application of 7.5Vdc to its base and, in turn, the rf preamplifier stage is disabled.

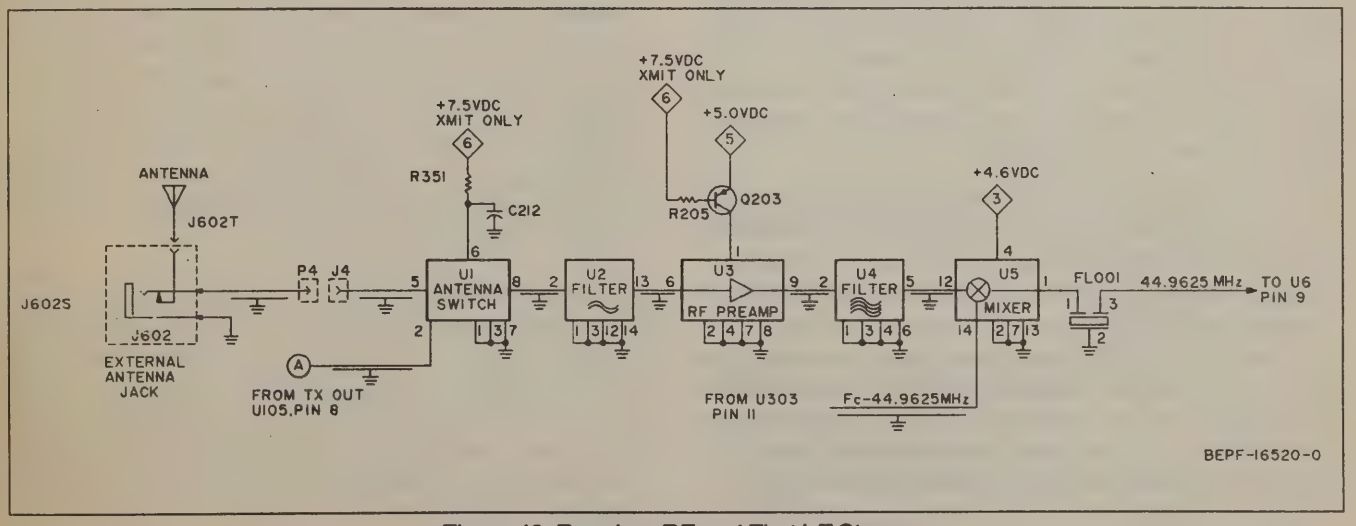


Figure 10. Receiver RF and First I-F Stages

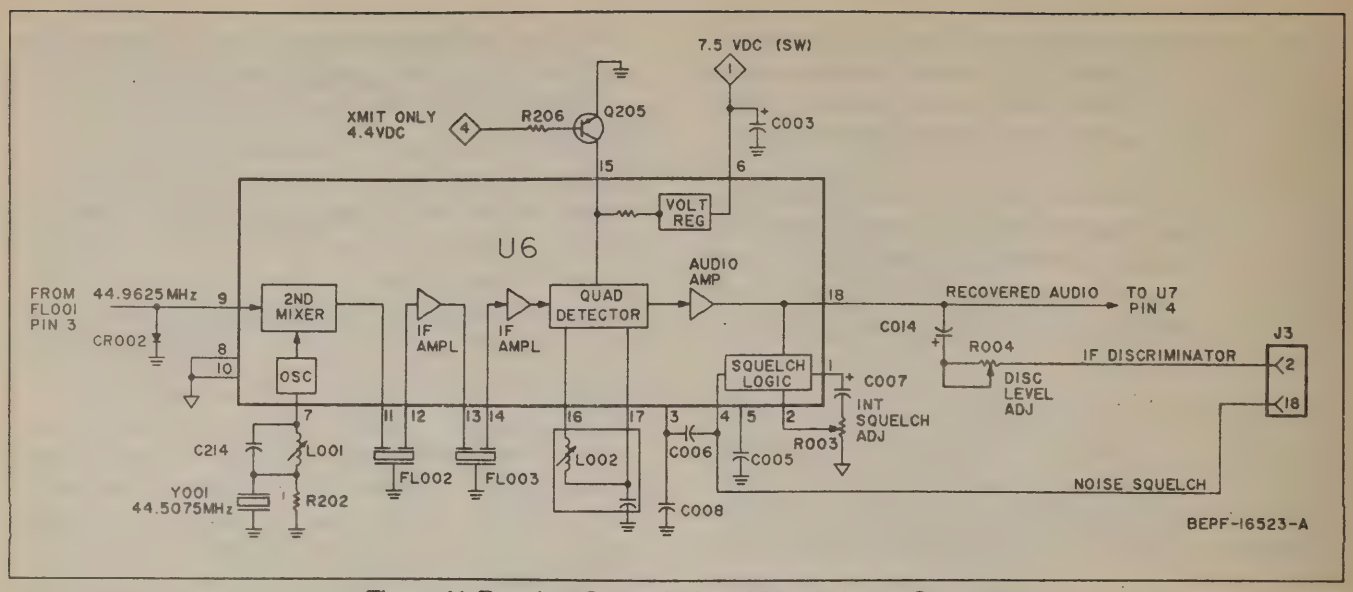


Figure 11. Receiver Second I-F and Discriminator Stages

The amplified output from U3 is passed to filter module U4, which contains a four-pole ceramic stripline filter. U4 provides further receive band selectivity and image rejection. It also attenuates spurious mixer injection signals. Insertion loss is approximately three dB.

The mixer module (U5) contains a signal mixing element that combines the receiver rf signal (851-870MHz) input at pin 12 with the receiver injection signal (806-825MHz) input at pin 14 to produce a difference frequency (first i-f) of 44.9625MHz at pin 1.

Crystal filter FL001 provides a 16kHz bandpass, centered at 44.9625MHz for first i-f selectivity and second i-f image rejection.

c. Receiver Second I-F and Discriminator Stages (See Figure 11)

The first i-f signal is applied through pin 9 of module U6 to a mixer stage, where it is combined with the local oscillator signal to produce a difference (second i-f) frequency of 455kHz. The oscillator operates at 44.5075MHz and is controlled by an external crystal (Y001). Warp coil L001 is adjusted to compensate for circuit component tolerances. Resistor R202 provides a dc path to ground and establishes the base-emitter bias for the oscillator.

An i-f amplifier boosts the second i-f frequency while two external ceramic filters (FL002 and FL003) provide the desired selectivity. The amplified, filtered and limited i-f signal is then applied to a quadrature detector circuit, where the audio component of the second i-f frequency is recovered. The quadrature detector coil (L002) is adjusted to center the detector frequency at 455kHz. The recovered audio is then buffered before it is coupled from U6 via pin 18 to the audio logic/regulator circuit (U7). Also, a portion of the audio output from pin 18 (IF DISCRIMINATOR signal) is passed to the controller via potentiometer R004.

The squelch detector contained in module U6 is a discriminator noise detection circuit that communicates with the controller via the NOISE SQUELCH line from pin 4. When the discriminator noise level exceeds the threshold level established by the setting of a potentiometer R003, pin 4 of U6 goes high, indicating the absence of a carrier signal. When a message is received (carrier present) the discriminator noise is suppressed and a low NOISE SQUELCH signal is sent to the controller via pin 4.

The voltage regulator contained in module U6 operates from 7.5Vdc applied to pin 6 and supplies a regulated 3.44Vdc to the module internal circuitry. In the transmit mode of operation, transistor Q205 is turned on, grounding the voltage regulator output and, in turn, disabling the module circuitry.

d. Receiver Audio and Squelch Circuits (See Figure 12)

The recovered audio from module U6 is applied to an audio preamplifier stage in de-emphasis module U7, via pin 4, where it is amplified, filtered, shaped, and coupled out through pin 11 to the volume control. Alert tones from the controller are also applied to the volume control. Audio from the volume control is returned through pin 2 of U7 and applied to the audio driver stage. Output from the audio driver is amplified by the power transistors and coupled to the speaker. If an external accessory is attached to the radio side connector, switch S602 will open, disconnecting the internal radio speaker.

The squelch logic in Module U7 responds to two signals from the controller ($\overline{\text{RX ENABLE}}$ and SPEAKER ENABLE) to squelch or unsquelch the audio preamplifier and audio driver stages, respectively. The $\overline{\text{RX ENABLE}}$ signal from the controller is low and the SPEAKER ENABLE signal is high, turning on both amplifier stages, when a carrier signal exceeding the preset threshold squelch level is detected (uncoded squelch mode).

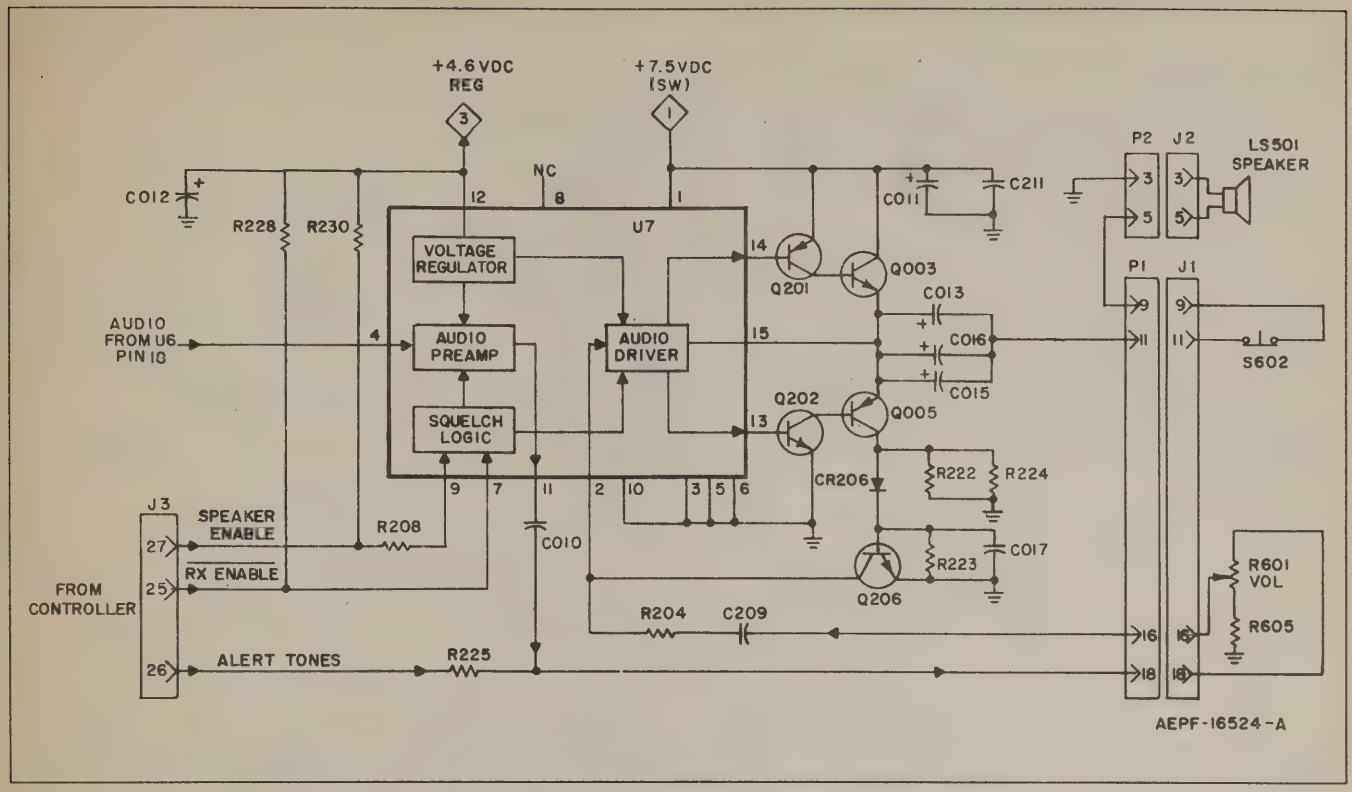


Figure 12. Receiver Audio and Squelch Circuits

When alert tones are generated, a high $\overline{\text{RX ENABLE}}$ signal is applied to pin 7 of U7 to disable the audio preamplifier, blocking any received audio. At the same time, a high SPEAKER ENABLE signal is applied to pin 9 of U7 to turn on the audio driver, allowing the tones to be passed to the speaker. During the absence of alert tones in the transmit mode, the SPEAKER ENABLE signal from the controller is low, preventing any signal from reaching the speaker.

e. Transmitter Audio Circuit (See Figure 13)

When PTT switch S603 is depressed, a low PTT signal is sent to the controller via pin 8 of connector J3 and grounds pin 1 of the microphone. The controller then supplies the enable signals to the voltage switching circuits to produce the required transmitter operating voltages. These transmit-only voltages also disable selected receiver circuits.

The IDC module (U5) performs a variety of functions. It amplifies the low level audio signal, and provides frequency shaping (pre-emphasis) and amplitude limiting. It also contains a low-pass "splatter" filter to remove any harmonics which may be generated by the amplitude limiter stage. Microphone audio is applied to pin 5 of U5 via coupling capacitor C102. After amplification and shaping, the audio signal is fed out through pin 2 to potentiometer R105 (IDC ADJ) which is adjusted to set the modulation limits of the transmitter. Zener diode VR210 protects the module from static discharge.

f. Transmitter RF Circuit (See Figure 14)

The modulated rf carrier frequency from the injection filter/switch module U103 is applied to pin 10 of the transmit buffer (U104) which contains a compression and limiting amplifier. The 4.4Vdc operating potential at pin 1 is applied during the transmit mode only. The transmit buffer module provides about 10dB gain with a low level input signal and about 2 or 3dB gain with a high level input signal. Thus, it attempts to maintain a constant output level (0.7 to 1mW) to drive the rf final power amplifier and keep the PA within its output specifications.

The rf final PA module (U105) shown in Figure 14 is used in 3-watt radios and produces an output of 4.1 watts. In 1-watt radios, the last amplifier stage of the module is replaced by a microstrip transmission line to reduce the output power to 1.4 watts.

The rf final amplifier has been designed with particular emphasis on achieving a constant output power at a constant current verses carrier frequency. When the PA is not drawing proper current due to supply voltage, temperature, or input drive variations, the ALC adjusts the power amplifier control voltage in an attempt to bring the output back to nominal.

The power amplifier current is sensed by monitoring the voltage drop across resistor R117 in the supply path. Changes in voltage across this resistor produce a change in the sense voltage at pin 5 with respect to pin 6 of ALC module U107. This change is amplified for output at pin 2 and through amplifier Q302 to Q106 is applied to rf PA pins 3 or 4, causing the rf final amplifier output to vary until equilibrium is established. A resistor divider circuit is used as a reference to limit the voltage at pin 2 to approximately 3.8Vdc.

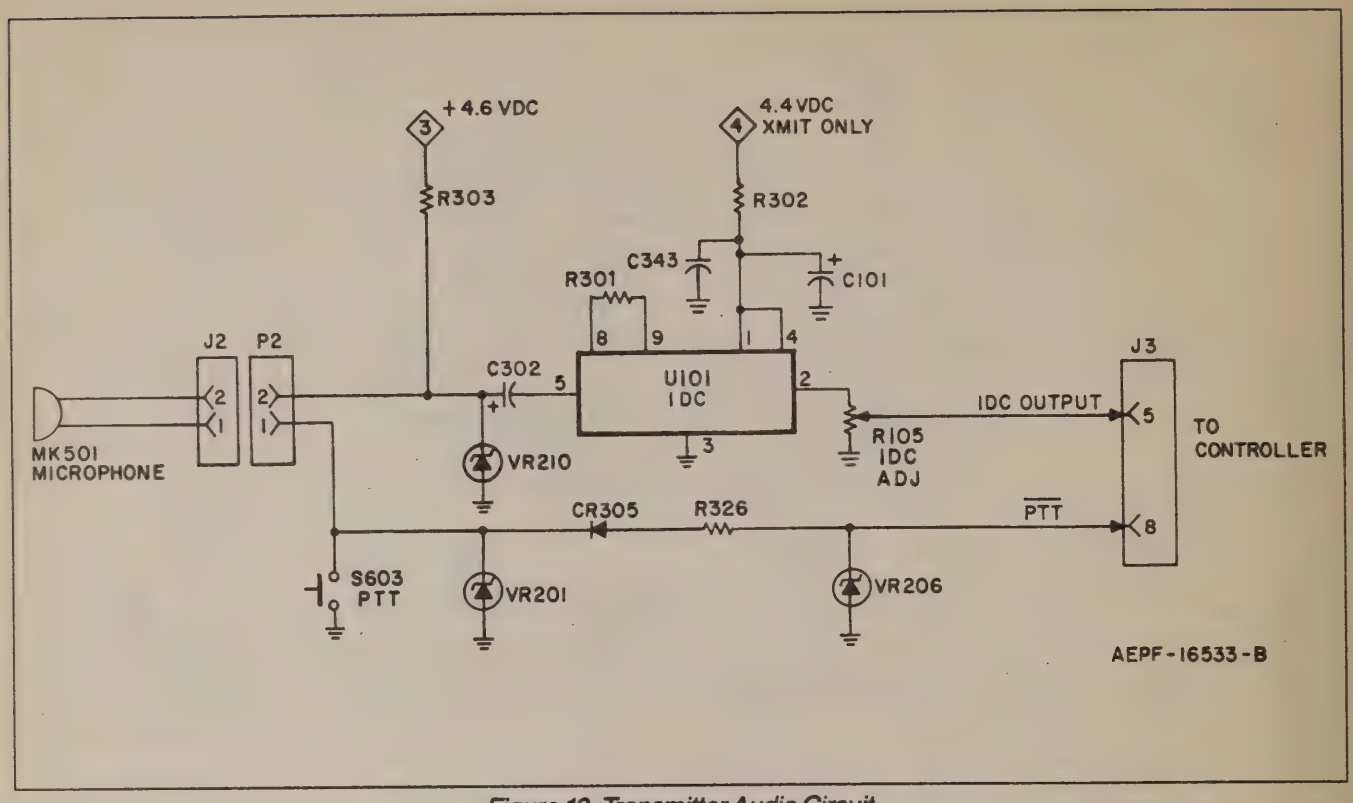


Figure 13. Transmitter Audio Circuit

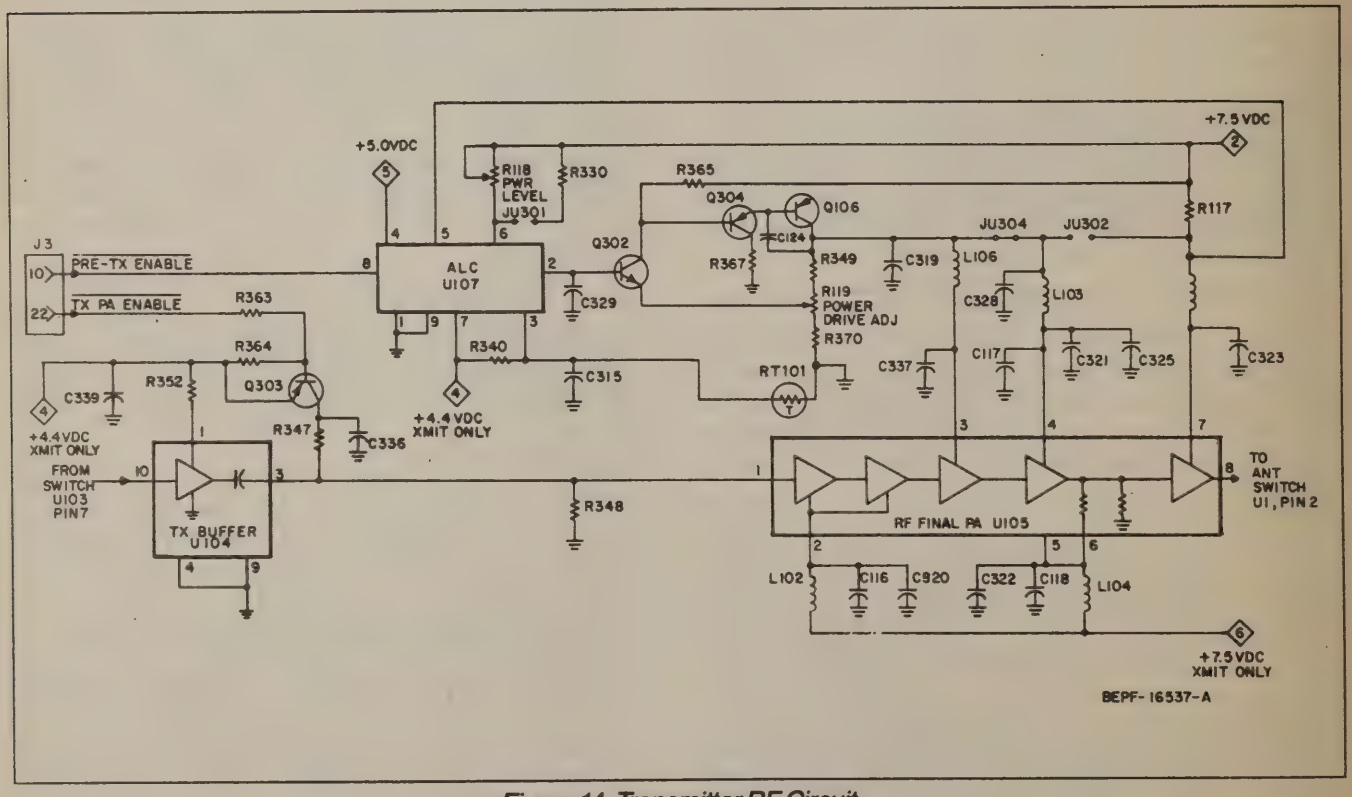


Figure 14. Transmitter RF Circuit

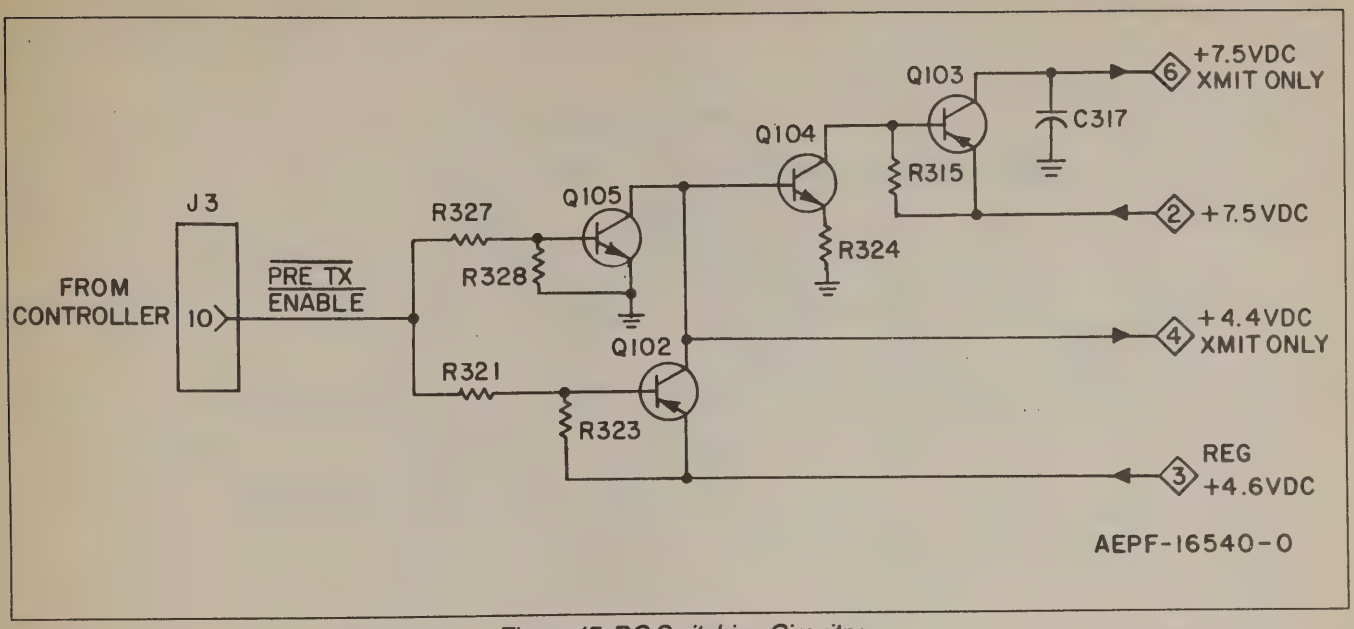


Figure 15. DC Switching Circuitry

Thermal cutback is incorporated into the ALC module by an amplifier with an external thermistor (RT101) that is physically located near the PA. If the case temperature of the PA becomes excessive, the resistance of the thermistor decreases, gradually lowering the control voltage.

A low PRE-TX ENABLE signal from the controller is applied to pin 8 of the ALC module when the PTT switch is depressed, however, until the VCO attains the proper stable transmitter output frequency, the TX PA ENABLE signal is held high to prevent the rf final amplifier from being enabled. When the signal TX PA ENABLE goes low, bias is applied to pin 1 of U105 to turn on the rf final amplifier stages.

g. DC Switching Circuits (see Figure 15)

When the PRE TX ENABLE goes low, Q105 turns off and Q102 turns on. This supplies XMIT 4.4Vdc to the transmitter circuits. This voltage turns on Q104 and Q103, thereby supplying XMIT ONLY 7.5Vdc to the transmitter circuits. The final PA stage voltage (pin 7 in 3W models and pin 4 in 1W models) is supplied directly from the battery. It is not controlled through on/off switch S601.

h. Controller Signal Processing Circuits

(1) Alert Tones (See Figure 16)

Alert tones from pin 13 of the microprocessor are generated as a five-volt square wave signal. The signal frequency, duration, and repetition rate (number of beeps) is determined by the situation that the tones are meant to identify, such as a keypad closure, private conversation, call alert, etc. The tones are attenuated by a resistor divider network (R458 and R459) and sent to the transceiver board via pin 26 of connector P3. When the alert tones are generated, the microprocessor sets the RX ENABLE and SPEAKER AUDIO ENABLE lines high, squelching the audio preamplifier to block any received signal and turning on the audio driver to pass the alert tones through to the speaker. Keypad chirps can be disabled.

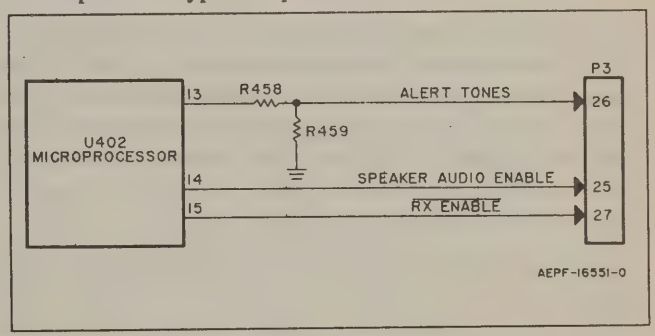


Figure 16. Alert Tone Signal Path

(2) Microphone Audio (See Figure 17)

The microphone audio signal from the IDC circuit is routed to the controller board at pin 5 of connector P3 (IDC INPUT) and coupled through capacitor C430 to U407, where it is processed for proper amplification. The signal is returned to the rf board via pin 3 of connector P3 (MOD OUT).

Three control lines determine the proper amplification for the audio signal while it is processed by U407. They are the TRANSMIT AUDIO ENABLE, CODED SQ, and RPT/TA lines.

When the TRANSMIT AUDIO ENABLE line is low, the audio signal is gated off from the rest of the internal circuitry in U407, thereby prohibiting the signal from mixing with digital data. This is required for highspeed and DTMF encode situations. When the TRANSMIT AUDIO ENABLE line is high, the audio signal is allowed to pass through to the next gain stage.

The audio signal is routed through one of two gain paths internal to U407 depending on the CODED SQ line logic. The CODED SQ line is high when audio is to be mixed with

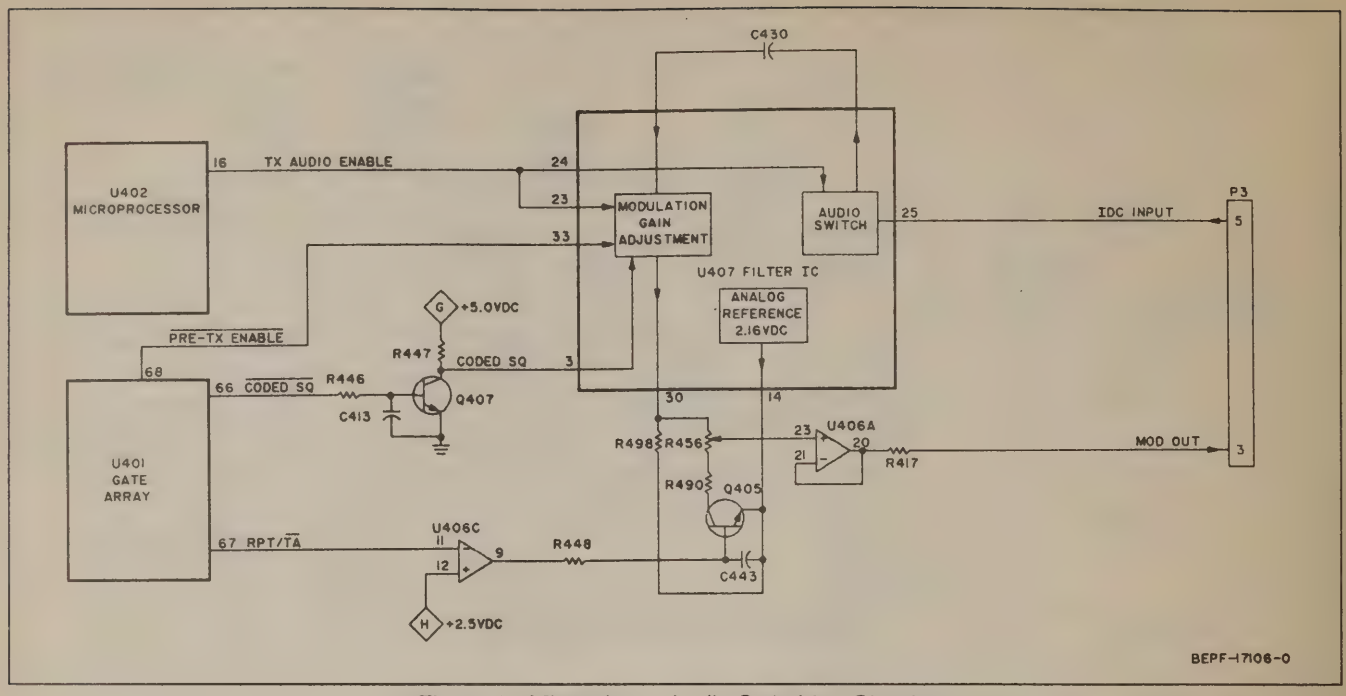


Figure 17. Microphone Audio Switching Circuits

digital data prior to being modulated. The CODED SQ line is low whenever a carrier squelch, or audio only, operation is required. This adjusts the modulation gain so that when a coded squelch subaudio signal is superimposed with the transmit audio signal, 5kHz deviation is not exceeded. The output of this gain block, present at pin 30 of U407, is applied through potentiometer R456 and R490 to Q405.

When the RPT/$\overline{TA}$ line is low, Q405 turns on, shorting R490 to pin 14 of U407, the analog ground for the IC. This creates a voltage divider stage where the signal at the wiper of R456 is coupled through buffer U406D and pin 3 of connector P3 (MOD OUT) to the transceiver board where it modulates the VCO and reference oscillator. When the RPT/$\overline{TA}$ line is high, Q405 turns off, thereby allowing the signal at pin 30 of U407 direct access through buffer U406D to pin 3 of connector P3 (MOD OUT). This signal adjustment is required to compensate for a varying modulation sensitivity characteristic of the VCO as it switches frequency ranges.

(3) Data Signals

In a trunked system, when the radio is powered up, the microprocessor is monitoring the control channel and receiving the signal being transmitted by the central controller (repeater) at all times. The central controller signal consists of data streams which cause the radio to perform specific functions. When the radio receives a data stream message indicating that another radio is attempting to make contact, the radio may transmit data that acknowledges receipt of that information. Another data stream from the repeater instructs the microprocessor to select a specific voice channel. The microprocessor then communicates with the transceiver board, and sets the synthesizer output to the required frequency.

(a) Received Data Signals (See Figure 18)

In the receive mode, the data signal from the quadrature detector on the transceiver board is routed to the controller board via pin 2 of connector P3 (DISC IN). The $\overline{\text{PRE-TX ENABLE}}$ line gates the signal path to U407 and its internal circuitry. In the receive mode, this line is high and U407 allows the received data signal to pass through and be processed by its receiver circuitry. In the transmit mode, the $\overline{\text{PRE-TX ENABLE}}$ line is low and U407 blocks the received data signal from its internal circuitry. When the signal passes through, it is amplified by a gain stage in U407 and routed out of U407 through pin 29 and R499 to pin 4 of connector P3 (BUFFERED DISC OUT).

The digital received data signal can be either high-speed (3600bps) or low-speed (150bps) in nature. The high-speed signal is approximately three times the amplitude of the low-speed signal and must be attenuated to match the low-speed signal amplitude prior to entering the digital filters. U407 performs this operation through the use of the $\overline{\text{LOW SPEED SELECT}}$ line. When a high-speed signal is received, this line is high, and the circuitry internal to U407 routes the signal through an impedance path to produce an approximate 0.2Vpp signal at the input of the filters. Next, with the $\overline{\text{LOW SPEED SELECT}}$ line still high, the signal is channeled through the high-speed 7-pole Bessel filter internal to U407, routed through pin 11 to the external high-pass filter consisting of R429 and C411, and injected to pin 13 of U407, the input to the center slicer.

When a low-speed signal is received, the $\overline{\text{LOW SPEED SELECT}}$ line is low, and the signal is routed through a different impedance path also internal to U407 again

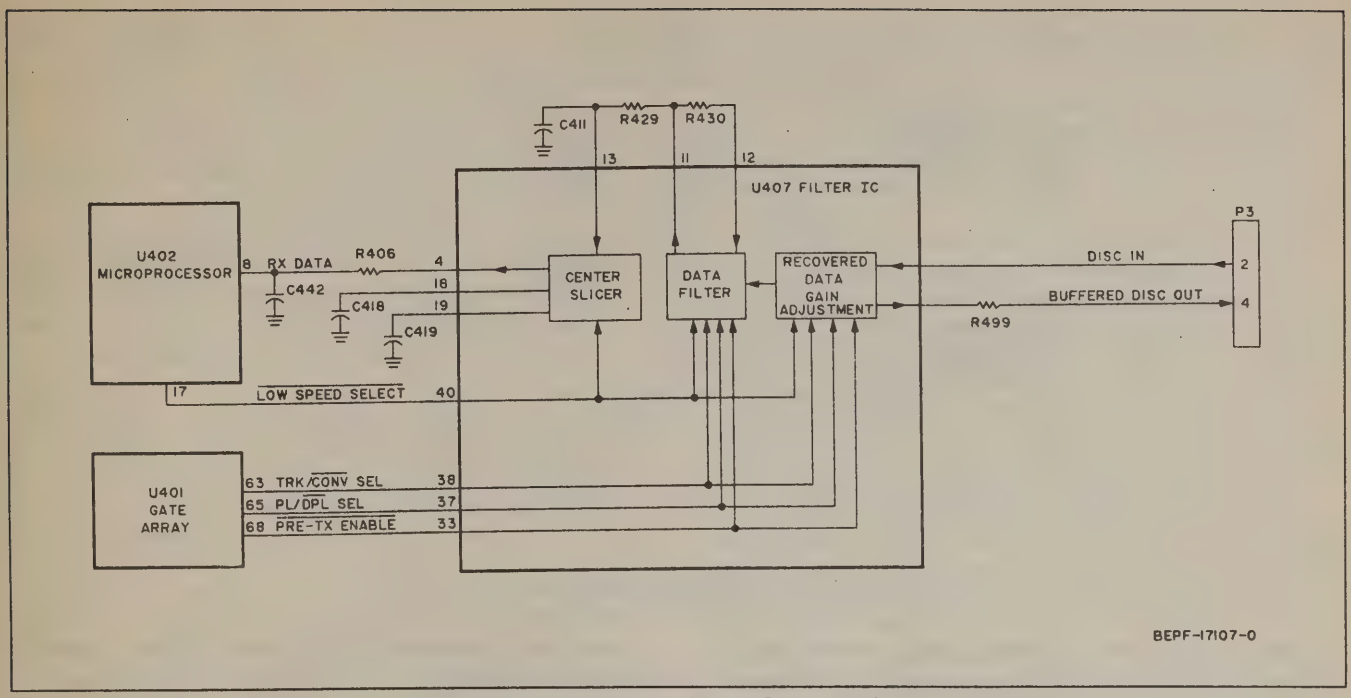


Figure 18. Received Data Signal Path

resulting in an amplitude of approximately 0.2Vpp prior to entering the filters. In this mode, the signal is routed through U407's low-speed 7-pole Chebyshev filter and the high-speed filter (in series) prior to passing through R429 and C411 to pin 13 of U407.

The center slicer circuit internal to U407 operates as an A-to-D converter for all signals present on pin 13 of the IC. Hysteresis is present on the circuitry to prevent the center slicer from toggling due to noise riding on the input signal. The circuit produces a high level (five-volt) output when the signal rises above the input signal's dc reference level, and a low (zero-volt) output when the signal drops below that level. The signal, however, is not always riding on a constant dc level. For example, the dc level may change when channels are switched, causing the reference level to change and then return to its previous level. The center slicer circuit tracks the varying reference level, thus enabling the circuit to generate the proper logic levels corresponding to the incoming signal.

The data signal to the center slicer is placed at the input to an internal comparactor to U407. The signal also goes through an RC network to the negative input of the comparator. Since the signal from the center slicer can be either high-speed or low-speed, precautions must be taken to select the proper RC time constant. While the resistor in this network is internal to U407, the capacitors are externally connected to U407. Depending whether the LOW SPEED SELECT line is high or low, C418 or C419 is accessed in this circuit, respectively. The capacitor is charged and discharged at a rate compared to the signal rate. If the dc level of the signal takes a big jump (greater than approximately 0.6 volts), internal diodes to the center slicer circuitry conduct, replacing the circuit's internal resitor. The current goes through the diodes, charging and discharging the capacitor heavily so that, instead of maintaining a certain reference level, the level follows the input dc level. Therefore, the center of the wave is referenced even if the dc level varies.

(b)Transmitted Data Signals (See Figure 19)

All data signals generated by the microprocessor, except the low group DTMF tones, are generated from pin 9 of the microprocessor on the TX DATA line and routed to pin 3 (MOD OUT) of connector P3, where they are routed to the transceiver board to provide data modulation. The transmit signal path rests predominantly internal to U407.

Because low-group and high-group DTMF tones are generated simultaneously, the high-group tones are output on the TX DATA line and the low-group tones are output from pin 20 of the microprocessor on the LOW GROUP DTMF line. Control line PL/DPL SEL switches gain paths internal to U407 for the low-group tone to control the DTMF twist for each tone generated. After these two tones are resistively combined, they are routed via the normal TX DATA signal path internal to U407.

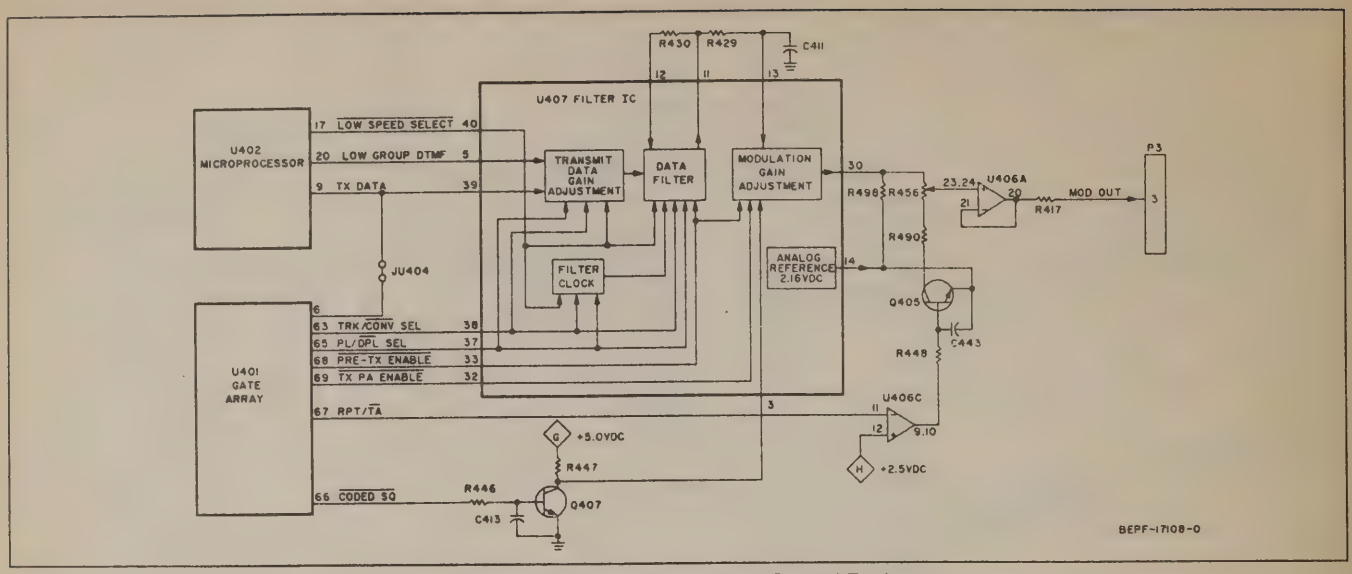


Figure 19. Transmitted Data Signal Path

Control lines are used to select the proper attenuation and filter paths for the various data signals depending on the operating mode of the radio, i.e., trunked or conventional. Table 3 illustrates the different states (logic levels) of the control lines for the varying conditions.

Table 3. Transmit Control Lines

CONTROL LINE	TRUNKING MODE			CONVENTIONAL MODE	
	HIGH SPEED	LOW SPEED	DTMF TONES	TONE PL	DIGITAL PL
LOW SPEED SELECT	1	0	1	0	0
PL/DPL SEL	X	X	*	1	0
RPT/TA	1	1	1	**	**
TX PA ENABLE	0	0	0	0	0
PRE-TX ENABLE	0	0	0	0	0
TRK/CONV SEL	1	1	1	0	0

X = DON'T CARE
* = 1 WHEN DIGIT 1, 2, 3, 4, 5, OR 6 ARE GENERATED; 0 WHEN DIGIT 7, 8, 9, *, 0, OR # ARE GENERATED
** = 1 FOR REPEATER OPERATION; 0 FOR TALKAROUND OPERATION

The data signal present on the TX DATA line is directed to pin 39 of U407 where it is processed for proper amplification. This signal is routed to a different gain stage located internal to U407 depending upon the type of signal being generated, i.e., high-speed, lowspeed, tone PL, or digital PL. In the case of DTMF tone generation, the high-group tone is directed through the high-speed gain stage and the low-group tone, channeled to pin 5 of U407, is routed to one of two gain paths in order to insure proper DTMF twist operation. The low-group tone gain path is controlled by the PL/$\overline{\text{DPL}}$ SEL line.

Once the input signal is internally processed for proper amplification, it is next processed through the filter section internal to U407. Both the 7-pole high-speed Bessel filter and 7-pole low-speed Chebyshev filter are switched capacitive in design and have variable rolloffs depending upon the clock rate applied to their internal timing network. The TRUNK/$\overline{\text{CONV}}$ SEL, $\overline{\text{PRE-TX ENABLE}}$, and PL/$\overline{\text{DPL}}$ SEL lines control two clock divider networks internal to U407 which divide the ECLK (pin 2 of U407) signal to clock rates corresponding to optimum filter rolloffs to both the Bessel and Chebyshev filters for each data type. The output of the filters is routed through pin 11 of U407, through the external lowpass filter of R429 and C411, and into pin 13. In transmit mode, the data signal internally routed in U407 through a final buffer stage to pin 30.

For the repeater operation, the transmitter requires a slightly higher amplitude to produce the same deviation as in talk-around. As with the microphone audio, the talk-around shift is accomplished by turning Q405 on and off. When the RPT/$\overline{\text{TA}}$ line is low, Q405 turns on, shorting R490 to pin 14 of U407, the analog ground for the IC. This creates a voltage divider stage where the signal at the wiper of R456 is coupled through buffer U406D and pin 3 of connector P3 (MOD OUT). When the RPT/$\overline{\text{TA}}$ line is high, Q405 turns off, thereby allowing the signal at pin 30 of U407 direct access through U406D to pin 3 of connector P3 (MOD OUT).

MAINTENANCE

1. INTRODUCTION

This section of the manual describes the disassembly and reassembly procedures, recommended repair procedures, special precautions regarding maintenance, and recommended test equipment. Each of these topics provides information vital to the successful operation and maintenance of the STX radio.

2. PREVENTIVE MAINTENANCE

The STX radio does not require a scheduled preventive maintenance program, however, periodic visual inspection and cleaning is recommended.

a. Inspection

Check that the external surfaces of the radio are clean, and that all external controls and switches are functional. A detailed inspection of the interior electronic circuitry is not needed or desired.

b. Cleaning

The following procedures describe the recommended cleaning agents and the methods to be used when cleaning the external and internal surfaces of the STX radio. External surfaces include the top housing, lower housing, and the battery case. These surfaces should be cleaned whenever a periodic visual inspection reveals the presence of smudges, grease, and/or grime. Internal surfaces should be cleaned only when the radio is disassembled for servicing or repair.

The only recommended agent for cleaning the external radio surfaces is a 0.5% solution of a mild dishwashing detergent, such as JOY®*, in water. The only factory recommended liquid for cleaning the printed circuit boards and their components is ISOPROPYL alcohol (70% by volume).

CAUTION

The effects of certain chemicals and their vapors can have harmful results on certain plastics. Aerosal sprays, tuner cleaners, and other chemicals should be avoided.

(1) Cleaning External Surfaces

(a) Polycarbonate Surfaces

The detergent-water solution should be applied sparingly with a stiff, non-metallic, short-bristled brush to work all loose dirt away from the radio. A soft, absorbent, lintless cloth or tissue should then be used to remove the solution and dry the radio. Make sure that no water remains entrapped near the connectors, cracks, or crevices.

(b) Silverized Surfaces

A non-metallic, soft-bristled brush should be used to apply the detergent-water solution to silverized surfaces, and a second non-metallic, soft-bristled brush (free of detergent, or rinsed in clean water) should be used to remove the detergent-water solution.

Upon completion of the cleaning process, a soft, absorbent, lintless cloth or tissue should be used (with a blotting action) to dry the frame and covers. The blotting action will prevent damage to the silverized conductive coating.

(2) Cleaning Internal Circuit Boards and Components

Isopropyl alcohol may be applied with a stiff, non-metallic, short-bristled brush to dislodge embedded or caked materials located in hard-to-reach areas. The brush stroked should direct the dislodged material out and away from the inside of the radio.

Alcohol is a high-wetting liquid and can carry contamination into unwanted places if an excessive quantity is used. Make sure that controls or tuneable components are not soaked with the liquid. Do not use high-pressure air to hasten the drying process, since this could cause the liquid to puddle and collect in unwanted places.

Upon completion of the cleaning process, use a soft, absorbent, lintless cloth to dry the area. Do not brush or apply any isopropyl alcohol to the frame, front cover, or back cover.

NOTE

Always use a fresh supply of alcohol and a clean container to prevent contamination by dissolved material (from previous usage).

3. DISASSEMBLY *(Refer to the exploded view in the STX service manual.)*

Disassembly of the radio involves removal of the major components listed below, one at a time, in the sequence described in the following paragraphs.

NOTE

1. Several special tools are required to completely disassemble the radio. Refer to the "Test Equipment and Service Aids" paragraph in this section of the manual.
2. Before proceeding, make sure that the radio is turned off.

a. Battery Removal

To remove the battery from the radio, proceed as follows:

Step 1. Hold the radio with the front of the radio facing up.

Step 2. Disengage the battery latch from the battery by pushing and holding the latch towards the top of the radio.

Step 3. With the battery latch disengaged, slide the battery from left to right to remove it from the baseplate on the bottom of the radio housing.

b. Gaining Access To Internal Components

CAUTION

The STX radio contains complementary metal-oxide semiconductor (CMOS) devices, which are highly susceptible to damage in handling due to static discharge. The entire printed circuit board should be treated as static sensitive. Damage can be latent, resulting in failures accuring weeks or months later.

DO NOT attempt to disassemble the radio without first referring to the "Safe Handling of CMOS Devices" paragraph in this section of the manual.

*JOY® is a registered trademark of Proctor & Gamble. Use of other dishwashing solutions could cause damage to the plastic parts.

Step 1. Remove the battery as described in paragraph a.

Step 2. Loosen the two large captive screws holding the baseplate, until the control-top housing is released. DO NOT remove the screws completely. They are held to the baseplate by O-rings.

Step 3. Lift the control-top housing assembly to remove the board/shield assembly from the lower housing (case).

Step 4. Remove the antenna by unscrewing it counterclockwise.

Step 5. Loosen the two captive screws (located on the top escutcheon) that hold the control-top housing to the board/shield assembly. DO NOT remove the screws completely. They are held to the escutcheon plate by O-rings.

Step 6. Lift the control-top housing off the board/shield assembly, disengaging the flex-circuit connector.

Step 7. Disconnect the coax cable from the board/shield assembly.

c. Removing the Controller Circuit Board

Step 1. Perform steps 1 through 7 of paragraph b.

Step 2. Loosen the four captive screws that hold the rear shield, and remove the shield. DO NOT remove the screws completely.

Step 3. Disengage the flex circuit board from the bottom of the front shield.

Step 4. Taking care not to damage the 28-pin edge connector that is located on the left side of the assembly (as viewed from the rear), gently slide the board to the right to disengage it from the connector.

d. Gaining Access to the Transceiver Board (Solder Side)

Step 1. Perform steps 1 through 4 of paragraph c.

CAUTION

If the battery is not removed, battery voltage will be present at the final rf power amplifiers and their control circuitry, even though the radio is turned off.

Step 2. Gently pry up on the left edge of the snap-on shield that is located behind the controller board (as viewed from the rear), and remove the shield to expose the solder side of the transceiver board.

e. Gaining Access to the Transceiver Board (Component Side)

Step 1. Perform steps 1 through 4 of paragraph c.

Step 2. Gently pry up on the right edge of the snap-on front shield (as viewed from the front of the radio), and remove the shield to expose the component side of the transceiver board.

NOTE

The speaker and microphone are attached to the front shield.

Step 3. Grasp the speaker-microphone cable near the transceiver board and disengage the connector from the transceiver board.

f. Removing the Transceiver Board from the Frame

Step 1. Perform steps 1 and 2 of paragraph d.

Step 2. Perform steps 2 and 3 of paragraph e.

Step 3. Remove the screw that secures the transmit power amplifier heatsink to the frame (located at the top left corner, as viewed from the front).

CAUTION

In the following steps, be careful not to break the PTT switch wire that is soldered from the frame to the solder side of the transceiver board.

Step 4. Grasp the frame so that the solder side of the transceiver board is toward you, and the 28-pin connector is to the left.

Step 5. Gently spread the frame and push the board towards you, applying pressure so that the right-hand and left-hand tabs of the transceiver board will clear the slots in the frame.

Step 6. Push both sides of the board towards you and remove the board.

g. Removing the Control-Top Housing Components

Step 1. Perform steps 1 through 7 of pargraph b.

CAUTION

When performing the following steps, be careful not to damage the painted surface inside the control-top housing.

NOTE

All control-top housing components, except the antenna jack/switch assembly, the CVC connector, and the program switch are connected to a common flexible circuit and must be removed as one unit.

Step 2. Loosen the setscrew(s) and remove the control knob(s).

Step 3. Remove the top escutcheon plate assembly.

Step 4. Remove the rubber seal(s) from the switch shaft(s).

Step 5. Remove the nut(s) from the switch shaft(s).

Step 6. Remove the two screws that hold the 20-pin connector.

Step 7. Remove the screw that holds the control switch plate. Push the subfleet switch slightly away from the CVC connector socket. The control switch plate may be removed using small pliers or tweezers.

NOTE

Do not attempt to remove the 10-pin connector socket from the control-flex circuit. It is soldered to the control-flex circuit.

Step 8. Disengage the 10-pin socket from the CVC connector, beginning at the top edge.

Step 9. Push the switch shaft(s) until clear of the mounting holes, and remove the control-flex circuit from the control-top housing.

Step 10. Remove the program switch button from the top housing.

NOTE

Be extremely careful not to lose the rf switch plunger, spring, and insulator which are exposed when the spanner nut is removed.

Step 11. Remove the spanner nut from the external antenna jack on the side of the radio.

Step 12. Remove the coax connector from inside the antenna bushing.

Step 13. Lift the antenna jack/switch assembly out of the top housing.

Step 14. To remove the CVC connector, gently depress the lock tab (top of the connector) and push the connector out of the housing.

h. Removing the Battery Latch

Step 1. Perform steps 1, 2, and 3 of paragraph b.

Step 2. Remove the screw that holds the negative battery contact. Be careful not to lose the lockwasher, contact, rubber pad (under the contact), and the square nut (inside the housing).

Step 3. While holding the latch slide, carefully pull the baseplate assembly from the lower housing.

Step 4. Carefully slide the latch out of the housing.

Step 5. Remove the exposed latch springs.

i. Removing the Front Cover

Step 1. Perform steps 1, 2, and 3 of paragraph b.

Step 2. Remove the two hex screws from the inside front of the lower housing (near the top).

Step 3. Pivot the top of the front cover outward and remove the cover.

j. Removing the LCD

Step 1. Perform steps 1, 2, and 3 of paragraph i.

Step 2. Taking care not to scratch the front cover, remove the escutcheon by prying up on one corner, and peeling it off.

Step 3. Bend the six bezel tabs straight up from the circuit board.

Step 4. Remove the bezel, insulator, LCD, and conductive elastomers through the opening in the front cover.

NOTE

Be careful not to damage the exposed gold contact pads on the display board.

4. REASSEMBLY *(Refer to torque specifications in the STX Service Manual.)*

CAUTION

DO NOT attempt to reassemble the radio without first referring to the "Safe Handling of CMOS Devices" paragraph in this section of the manual.

a. Replacing the Display Element

NOTE

Use a new bezel and escutcheon when replacing the LCD element. The LCD contact area and the gold plated area on the printed circuit board that mate with the conductive elastomers must be clean and free from all dust and dirt particles for proper LCD operation.

Step 1. Remove any residual adhesive from the front escutcheon sealing surface.

Step 2. Place the new LCD bezel face down on a clean, flat surface, and insert the insulator.

Step 3. Insert the LCD unit face down, and place the conductive elastomers on the contact areas.

Step 4. Hold the bezel face down and insert the tabs of the bezel into the slots in the printed circuit board.

Step 5. Hold the bezel firmly against the circuit board to compress the elastomers, and bend the bezel tabs down on the circuit board.

Step 6. Place the new escutcheon on the front cover assembly, and press firmly to assure adequate sealing.

b. Replacing the Front Cover Assembly

Step 1. Position the bottom tabs of the front cover assembly into the slots at the bottom of the lower housing (case).

Step 2. Push the front cover assembly forward against the front of the lower housing assembly to seat the O-ring.

Step 3. Replace the two hex screws (inside top front of lower housing) and torque according to the specifications in the STX Service Manual.

c. Replacing the Battery Latch and Base Plate

Step 1. Insert the two springs into their proper holes, and replace the latch slide.

Step 2. Position the baseplate and press it firmly to compress the springs.

Step 3. Holding the baseplate in place, insert the negative contact square nut into its hole in the inside bottom of the lower housing assembly. Make sure that the O-ring is in place, around the square nut.

Step 4. Install the negative battery contact, being sure that the rubber pad is in place in the cup of the contact.

Step 5. Replace the screw and lockwasher in the negative battery contact, and tighten the screw securely.

d. Replacing the Antenna Switch Assembly

Step 1. Insert the switch into the control-top housing.

Step 2. Insert the coax connector inside the antenna bushing (top of radio), but do not tighten until step 5.

Step 3. Install the insulator in the external antenna connector (side of radio).

Step 4. Insert the spring and plunger in the external antenna connector.

Step 5. Replace the spanner nut on the external (side) antenna connector. Securely tighten both the spanner nut on the side of the radio, and the coax connector inside the antenna bushing on top of the radio.

e. Replacing the CVC Connector

Step 1. Make certain that the O-ring is in place behind the connector flange. Orient the key tabs on the flange of the connector to the key slots on the control-top housing.

Step 2. Insert the connector into the control-top housing, and press firmly until the locking tabs lock in place inside the control-top housing.

f. Replacing the Control and Switches

Step 1. Insert the program switch into its hole.

Step 2. Engage the 10-pin socket with the CVC connector, and push the socket firmly onto the connector.

Step 3. Insert the switch shaft(s) into the proper hole(s).

Step 4. Replace the program switch plate, and tighten the screw securely.

Step 5. Replace the two screws that hold the 20-pin connector to the control-top housing.

Step 6. Replace the switch shaft nut(s), and tighten securely.

Step 7. Replace the rubber seal(s) around the switch shaft(s).

Step 8. Replace the top escutcheon plate assembly.

Step 9. Replace the switch knob(s), and tighten the setscrew(s) securely.

g. Reassembling the Board/Shield Assembly

Step 1. Viewing the transceiver board from the solder side with the asssembly upright, insert the two tabs (right-hand side) into the two slots in the frame. Be sure to route the PTT wire in the notch in the transceiver board to avoid pinching.

Step 2. Spread the left side of the frame slightly, and press the left edge of the transceiver board until the two tabs (left side of board) are engaged in the two slots in the frame.

Step 3. Replace the screw attaching the PA heatsink to the frame and tighten it securely.

Step 4. Place the VCO clip between frame and U11 synthesizer as shown and include the insulators.

Step 5. Reconnect the speaker-microphone to the transceiver board.

Step 6. Replace the snap-on front shield, being sure to route the speaker-microphone wires to avoid pinching. Be sure that all shield tabs are outside of the frame.

Step 7. Route the coax cable correctly through the middle shield. Replace the middle shield.

Step 8. Replace the controller board, and slide the board to the left into the 28-pin connector until properly positioned.

Step 9. Push the display-flex circuit board up under the two clips on the front shield.

Step 10. Replace the rear shield, and tighten the four screws securely. Torque according to the specifications in the STX Service Manual.

h. Final Reassembly Stage

Step 1. Reconnect the coax connector to the board/shield assembly.

Step 2. Position the board/shield assembly into the control-top housing, and tighten the two screws on the top of the control-top housing. Torque according to the specifications in the STX Service Manual.

Step 3. Insert the board/shield assembly into the lower housing (case) and tighten the two large screws on the baseplate. Torque according to the specifications in the STX Service Manual.

Step 4. Replace the battery.

5. SAFE HANDLING OF CMOS DEVICES

Complementary metal-oxide semiconductor (CMOS) devices are used in the STX radio. While the attributes of CMOS devices are many, their characteristics make them susceptible to damage by electrostatic or high voltage charges. Damage can be latent, resulting in failure occuring weeks or months later. Therefore, special precautions must be taken to prevent device damage during disassembly, troubleshooting, and repair. The following handling precautions are mandatory for CMOS circuits, and are especially important in low humidity conditions.

a. All CMOS devices must be stored or transported in conductive material so that all exposed leads are shorted together. CMOS devices must not be inserted into conventional plastic "snow" or plastic trays of the type that are used for storage or transportation of other semiconductor devices.

b. All CMOS devices must be placed on a grounded bench surface and the technicians must ground themselves prior to handling the devices. This is done most effectively by having the technician wear a conductive wrist strap in series with a 100k-ohm resistor to ground.

c. Do not wear nylon clothing while handling CMOS circuit.

d. Do not insert or remove CMOS devices with power applied. Check all power supplies to be used for testing CMOS devices, and be certain there are no voltage transients present.

e. When straightening CMOS device leads, provide ground straps for the apparatus used.

f. When soldering, use a grounded soldering iron.

g. All power must be turned off in a system before printed circuit boards containing CMOS devices are inserted, removed, or soldered.

6. REPAIR PROCEDURES AND TECHNIQUES

CAUTION

Leadless component technology requires the use of specialized equipment and procedures for repair and servicing of the STX radio. If you are not totally familiar with leadless component repair techniques, it is strongly recommended that you either defer maintenance to qualified service personnel and service shops or take the recommended video taped leadless component repair training program, MAV-PACK 3 (VID-952) and F.A.S.T. Number 9 (see paragraph 7b, Service Aids and Recommended Tools, in this section). This is of paramount importance as irreparable damage to the radio can result from service by unauthorized persons. Unauthorized attempts to remove or repair parts may void any existing warranties or extended performance agreements with the manufacturer. For module extraction, please refer to Portable Products Technicians Guide TT-901A and STX Technician's Guide TT-406.

a. Parts Replacement and Substitution

Special care should be taken to be as certain as possible that a suspected component is actually the one at fault. This special care will eliminate unnecessary unsoldering and removal of parts, which could damage or weaken other components or the printed circuit board itself.

When damaged parts are replaced, identical parts should be used. If the identical replacement component is not locally available, check the parts list for the proper Motorola part number and order the components from the nearest Motorola Communications Parts office listed in the "Replacement Parts Ordering" section of this manual.

b. Rigid Circuit Boards

The STX radio uses bonded multi-layer printed circuit boards. Since the inner layers are not accessible, some special considerations are required when soldering and unsoldering components. The printed through holes may interconnect multiple layers of the printed circuit. Therefore, care should be exercised to avoid pulling the plated circuit out of the hole.

When soldering near the module socket pins, use care to avoid accidentally getting solder in the socket. Also, be careful not to form solder bridges between the module socket pins. Closely examine your work for shorts due to solder bridges.

When removing modules with metal enclosures, be sure to desolder the enclosure ground tabs as well as the module pins.

c. Flexible Circuits

The flexible circuits are made from a different material than the rigid boards, and different techniques must be used when soldering. Excessive prolonged heat on the flexible circuit can damage the material. Avoid excessive heat and excessive bending. For parts replacement, use the ST-1087 Temperature-Controlled Solder Station with a 600° or 700° tip, and use small diameter solder such as ST-633. The smaller size solder will melt faster and require less heat being applied to the circuit.

To replace a component on a flexible circuit, grasp the edge of the flexible circuit with seizers, near the part to be removed, and pull gently. Apply the tip of the soldering iron to the component connections while pulling with the seizers. Do not attempt to puddle out components. Prolonged application of heat may damage the flexible circuit.

7. TEST EQUIPMENT AND SERVICE AIDS

The following paragraphs describe the test equipment and service aids required for maintaining the STX radio. Your Motorola sales representative will assist in analyzing your specific requirements and help you select the latest available equipment to suit your individual needs. In addition, your sales representative can advise you of the availability of new test equipment and service aids that become available after the printing of this manual.

a. Recommended Test Equipment

The list of equipment contained in Table 4 includes all of the standard test equipment required for servicing two-way portable radios, as well as several unique items designed specifically for servicing the STX radio. Battery operated test equipment is recommended when available. The "Characteristics" column is included so that equivalent equipment may be substituted; however, when no information is provided in this column, the specific Motorola model listed is either a unique item or substitution is not recommended.

Table 4. Test Equipment

MOTOROLA MODEL NO.	DESCRIPTION	CHARACTERISTICS	APPLICATION
R2210A or R2021D	Service Monitor	This monitor will substitute for items with an asterisk (*)	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment
*R1047A or R1049A	Digital Multimeter		Two meters recommended for ac/dc voltage and current measurements The R1049A has an additional 2 ohms full scale range used to detect internal short circuits in the digital circuitry on the controller board
*R1150	Code Synthesizer	67 to 161.4Hz tones	Used with service monitor for injection of PL tones
*S1053D *SKN6008A *SKN6001A	AC Volt Meter Power Cable for Meter Test Leads for Meter	1mV to 300V, 10-megohm input impedance	Audio voltage measurements
*R1053A	Dual-Trace Oscilloscope	10MHz bandwidth 10mV/cm	Waveform measurements
*S1350C *ST1232B *T1013A	Watt Meter Plug-in Element RF Dummy Load	50-ohm, ±5% accuracy 5 Watts, maximum 0-1000MHz, 300W	Transmitter power output measurements
S1339A	RF Millivolt Meter	100uV to 3V rf 10kHz to 1.2GHz	RF level measurements
*R1013A	SINAD Meter		Receiver sensitivity measurements
S1347D	DC Power Supply	0-20Vdc, 0-5 Amps current limited	Bench supply for 7.5Vdc
RTX4005A RTX4079A	Portable Test Set and Test Cable	-----	Enables convenient connection to the accessory jack, with switching for complete testing of radio
PLN7065A	Battery Tester /Reconditioner	-----	Battery capacity testing
ST1176	Battery Charger Tester	-----	Permits rapidly checking the significant charger parameters

* R2210A or R2021D will substitute for items with an asterisk (*).

b. Service Aids and Recommended Tools

Table 5 itemizes the service aids and tools designed specifically for servicing the STX radio, as well as the more common tools required to disassemble and properly maintain the radio. These kits and/or parts are available from the Motorola Communications Parts office listed in the "Replacement Parts Ordering" section of this manual.

(1) Technician's Guide TT406-Servicing The STX "Handie-Talkie" Portable Radio

This technician's guide will provide step-by-step procedures for troubleshooting the STX transceiver and controller boards. Also included are alignment, programming, and operation procedures for the RSX-4057A Repair Station.

(2)MAV-PACK 3 (VID-952)

The VID-952 Motorola Audio Visual Package (MAV-PACK) is a video tape training program on leadless component repair techniques. This VHS format video cassette and supplemental literature describe the removal and replacement of leadless components using the following specialized equipment:

- RRX-4033 Laurier Hot Gas Bonder
- RPX-4234A Regulator and Hardware Kit
- 0180386A62 Heated Tweezers
- RSX-1002 Desoldering Station
- RSX-1008 Weller Soldering Station

This MAV-PACK is strongly recommended for technicians who intend to service this and other Motorola radios using leadless components. The VHS videotape is in standard half-inch format.

(3)F.A.S.T. Number 9 - Using The RSX-4057A Desoldering Station

This videotape details the entire procedure, from initial set-up to replacing a leadless component on the STX controller board, using the Hot Air Repair Station.

Also available from National Service Training are two MAV-PACK 3's, titled:
VID-305 - Servicing The STX Trunked Radio - Part 1
VID-306 - Servicing The STX Trunked Radio - Part 2
These two video tapes describe the theory of operation and troubleshooting techniques for servicing the STX radio. These MAV-PACKs, as well as others are available from:

Motorola C&E Inc.
National Service Training Center
1300 N. Plum Grove Rd.
Schaumburg, Illinois 60173

c. RPX Kit Structures (Parts Breakdown)

Three unique "RPX" kits were created to provide a convenient means for service shops or repair depots to order all of the essential tools and service aids required for disassembly, servicing, and reassembly of the STX radio. The following parts lists, Tables 6 through 8, itemize the contents of these kits so that shops already equipped with some of the items may order individual tools or aids to supplement their existing inventory.

Table 5. Service Aids

MOTOROLA PART NO.	DESCRIPTION
RPX1008A	Service Aids Kit (See Table 6)
RPX1009A	Torque Screwdriver and Bits Kit (See Table 7)
RSX4057A	Hot Air Repair Station
RPX4604A	Tuning Tools Kit (See Table 8)
MAV-PACK 3/VID-952	Leadless Component Repair Techniques Audio Visual Package
0180333B61	Desoldering Station, 110V Model
0180333B62	Desoldering Station, 220V Model
0180386A81	Micro Tip Soldering Iron, 110V Model
0180386A82	Static Protection Kit
0180386A86	Micro Tip Soldering Iron, 220V Model
6680375A75	.036" ID Tip
6680387A59	Resistance Tweezers

8. FIELD PROGRAMMING INFORMATION

The STX radio can be field-programmed. Field programming requires the Motorola L1240A System Expansion Kit plus an IBM PC, IBM PC/XT, or compatible computer system with the following minimum features:

- One double-sided floppy disc drive
- 256k of memory
- Two asynchronous serial ports (see note)
- One UDS212A/D external modem (see note)

NOTE

A Hayes Smartmodem 1200B (or equivalent internal modem) may be used in place of the external modem. In that case, only one asynchronous serial port is required.

If an existing computer system is not available, the Motorola T5135A Field Programming system can be ordered. This kit includes the L1239A Basic Computer System Kit and the L1240A System Expansion Kit. These kits are structured as shown in Tables 9 through 11.

Table 6. RPX1008A Service Aids Kit

MOTOROLA PART NO.	DESCRIPTION	APPLICATION
RTK4079A	Interface Test Cable	Connects radio to RTX4005A Test Box
RTK4080A	Control Top Extender	Extends control top for troubleshooting
RTK4087A	CVC TX Power Cable	Measuring power through radio side connector
RTL4199A	Battery Block	Interconnects radio to power supply
RTL4206A	Battery Block Adapter	Connects radio to battery block without lower housing
RTL4207A	Controller Board Extender	Extends controller board for troubleshooting
RTL4208A	Test Probe	50-ohm high-frequency probe
5880348B33	Antenna RF Connector	Routing of signals to and from antenna port of radio

Table 7. RPX1009A Torque Screwdriver and Bits Kit

MOTOROLA PART NO.	DESCRIPTION	APPLICATION
RSX4043A	Torque Screwdriver	Handle for bits listed below
6605535Q01	Spanner Nut Bit	Side connector retainer
6605536Q01	Allen Wrench Bit	Front cover screws
6605537Q01	Bristol Bit	Control knob setscrews
6680321B78	Phillip's Bit "B"	#2-56 Philpan screws
6680321B79	Phillip's Bit "C"	#4-40 Philpan screws
6680321B86	Phillip's Bit "A"	#2-56 Philpan screws
6680334B37	Extension Bit	Antenna bushing
6680334B38	Screwdriver Bit	Antenna bushing
6680334B39	Hex Socket Screw Bit	Control top screws
6680334B41	Hex Nut Bit	Volume control hex nut
6680342A62	Spanner Nut Bit	RF jack
6680342A63	Bit	Subfleet switch
6680342A66	Bit	Antenna connector threaded coax pin

Table 8. RPX4604A Tuning Tools Kit

MOTOROLA PART NO.	DESCRIPTION	APPLICATION
6605106N01	Tuning Tool	Squelch threshold
6605147J01	Tuning Tool	Potentiometers, local oscillator coil, quad detector

Table 9. T5135A Field Programming System

MOTOROLA PART NO.	DESCRIPTION
L1239A	Basic Computer System Kit
L1240A	System Expansion Kit

Table 10. L1239A Basic Computer System Kit

MOTOROLA PART NO.	DESCRIPTION
TDN7045A	Asynchronous Serial Adapter
TDN7046A	Display & Printer Adapter
TDN7047A	Monochrome Monitor
TDN7249A	IBM PC with 256k RAM & 2 Disc Drives
TDN7250A	UDS 1200-PC or Hayes Smartmodem

Table 11. L1240A System Expansion Kit

MOTOROLA PART NO.	DESCRIPTION
TDN7050A	Programming Adapter Cable
TDN7251A	Radio Interface Module (RIM)
TDN7252A	Programming Disc
TDN7253A	Wall-Mounted Power Supply
TDN7254A	Radio Programming Cable
68P810xxCxx	User's Manual

Refer to the User's Manual supplied with the L1240A System Expansion Kit for system programming information and instructions for requesting a user's log on ID number that will allow access to the Motorola computer system.

NOTE

Consult your Motorola Sales Representative for requirements regarding access to the Motorola computer system.

Figure 20 shows a typical system intercabling setup for programming the STX radio.

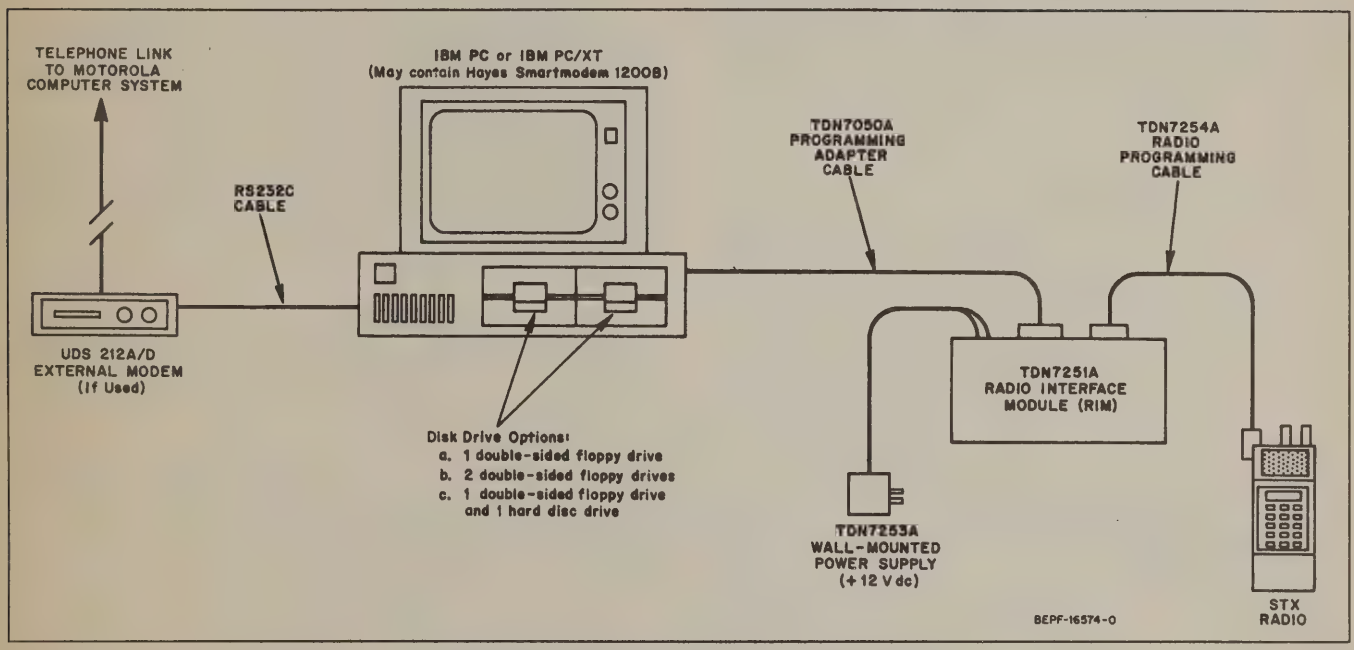

TELEPHONE LINK TO MOTOROLA COMPUTER SYSTEM
IBM PC or IBM PC/XT (May contain Hayes Smartmodem 1200B)
TDN7050A PROGRAMMING ADAPTER CABLE
TDN7254A RADIO PROGRAMMING CABLE
RS232C CABLE
UDS 212A/D EXTERNAL MODEM (If Used)
Disk Drive Options:
a. 1 double-sided floppy drive
b. 2 double-sided floppy drives
c. 1 double-sided floppy drive and 1 hard disc drive
TDN7251A RADIO INTERFACE MODULE (RIM)
TDN7253A WALL-MOUNTED POWER SUPPLY (+12 V dc)
STX RADIO
8EPF-16574-0

Figure 20. Programming System Intercabling

TROUBLESHOOTING

1. INTRODUCTION

Built into the STX software are several routines designed to aid in testing and troubleshooting the radio: The "test mode" simulates conventional two-way radio operation for evaluation of the transmitter and receiver circuitry using standard bench test equipment. A "power-up self test" diagnostic routine is executed every time the radio is turned on to check the digital logic circuitry on the controller board. If the self test fails, various audio tones are generated to identify specific malfunctions. In addition, the display front cover assembly has an "internal test mode" that allows it to be serviced independent of the radio.

In conjunction with the effective use of the radio schematic diagrams and the troubleshooting information contained in this section of the manual, the above features should significantly reduce repair time and allow the service technician to place the radio back in operation.

2. POWER-UP SELF TEST

The "power-up self test" diagnostic routines are designed either to: (1) verify that the digital logic circuits contained on the controller board are functioning properly (no tones generated and display normal) or; (2) if a portion of the digital circuitry is defective, identify the specific problem area by generating a unique tone or tone sequence. When tones associated with component failures on the controller board are generated, all segments of the display will be lit and there will be no user feedback. Certain tones are also generated that are related to problems in other sections of the radio.

NOTE

Under normal operating conditions, the STX radio generates a variety of tones that indicate the current status or operational mode. The service technician should be familiar with these tones, and be able to recognize the difference between normal operation and the different failure modes.

Table 12 lists the tone sequences that identify specific failures on the controller board.

Table 12.
Controller Board Failures Tone Sequences

TONE SEQUENCE	POSSIBLE COMPONENT FAILURE
One 1-kHz Beep Each Second	U402 Microprocessor (Internal RAM)
Two 1-kHz Beeps Each Second	U403 External RAM
Three 1-kHz Beeps Each Second	U401 Gate Array (Watchdog Circuit)
Four 1-kHz Beeps Each Second	U402 Microprocessor (Internal ROM)
Five 1-kHz Beeps Each Second	U404 External ROM (or UVROM)
450Hz Tone for One Second Followed by 163Hz Continuous Tone	U405 EEPROM or Dead Battery

Table 13 lists the possible tones and symptoms indicating failures on power-ups relating to problems in other sections of the radio.

Table 13. Power-Up Failures Tone Sequences

SYMPTOMS		POSSIBLE SOURCE OF PROBLEM
TONE SEQUENCE	OTHER	
450Hz Tone for One Second Followed by 163Hz Continuous Tone	Display Dim Weak Tones	Dead Battery or EEPROM Failure
900Hz Chirp Only	"EMER" Message on Solid No Key Feedback	S604 Control Button Shorted (Emergency Call Option)
900Hz Chirp Followed by 163Hz Continuous Tone	"EMER" Message Flashing	S604 Control Button Shorted (Emergency Call Option, Unit Out of Range)
900Hz Chirp Followed by One or Four More	"EMER" Message Solid or Flashing System – Subfleet Displayed	Emergency Alarm in Range
One Low-Pitched Chirp Only	Display Normal	S604 Control Button Shorted (No Function in System)
900Hz Chirp Followed by RX Unmute	Upper Half of Display Not Lit No Key Feedback	Shorted Serial Bus
163Hz Continuous Tone	TX Indicator Lit when Not Transmitting	TX Power Sensed in Receive Mode
	Display Normal	Illegal Rotary Switch Position
	systems or Subfleets beyond those Assigned to Radio Displayed	U401 Gate Array Not Sensing All Four Rotary Inputs Correctly
150Hz Continuous Tone	Display Normal	PTT Switch Shorted, Unit Out of Range, or Conventional RX-Only System
No Tones	LCD Blank, LED's Not On, No Key Feedback, but BATT Indicator will Flash if Low Battery	STX Radio Operation Inhibited by Dynamic Regrouping Command See Note Below

NOTE — STX radios can be "turned off" or inhibited by a command received through a trunking system. In this mode, the radio is operational but will ONLY respond to a transmitted command to "turn back on" again. This command allows units to be disabled if lost or stolen. When in such a "turned off" state, test mode is not available. With Display models, it is easy to determine whether the radio is in such a state: the display will be blank until the battery voltage drops below the "low battery" threshold, and the BATT annunciator on the display will start to flash. On both display and non-display models, the keypad, PTT switch, and the control button will yield no tones and have no affect. Control channel data can be seen at the discriminator output, if the unit is in range of the trunking system that sent the inhibit command to the radio.

3. RADIO TEST MODE

In both the trunking and conventional modes of operation, the microprocessor that controls the radio is constantly executing predefined tasks that would normally prevent convenient testing of the transceiver circuitry. However, another mode of operation (test mode) is available. In the test mode, the operation of a conventional two-way radio is simulated, providing the service technician with means to evaluate test, and align the transceiver circuitry using conventional bench test equipment. The functions that can be selected in the test mode are:

- Display the radio serial number and software version.
- Receive and transmit on customer trunking frequencies, or on any of three pairs of fixed frequencies.
- Specify the type of receiver squelch and transmitter modulation.
- Indicate synthesizer unlock, low battery, and transmit conditions.

Test mode operator feedback is both audible and visual, however, the LCD display is not required to service the radio in this mode. The STX TEST SETUP illustration contained in Service Manual 68P81049C80 depicts the test equipment configuration required to properly diagnose radio problems in the test mode.

CAUTION

All transmissions in the test mode must be into an rf dummy load, not through an antenna.

a. Special Terms and Definitions

The terms "slow key," "quick key," and "mode" are used in the following paragraphs to indicate the duration of the PTT switch depression and the selected transmit and receive functions. These terms are defined as follows:

- SLOW KEY -- Depress and hold the PTT switch.
- QUICK KEY -- Press the PTT switch momentarily.
- MODE -- the selected pair of receive and transmit functions for the current operating frequency. The five operating modes are listed in Table 14.

Table 14. Operating Modes

MODE	RECEIVE FUNCTION	TRANSMIT MODULATION
US (UnSquelched)	Receiver On	Mic Audio Only (Having removed coded information, maximum deviation is 3.6-4.0kHz
LS (Low Speed)	Receiver On	Connect Tone + Mic Audio
HS (High Speed)	Receiver Off	1800Hz Sine Wave
CL (CaLibrate)	Receiver Off	75Hz Square Wave
D0 (DTMF Tones)	Receiver On if Carrier Signal is Present	DTMF Tone Pair 0

b. Operation

Operation of the radio in the test mode simply involves frequency and mode selection. During test mode operation, the radio is receiving on the currently selected frequency and, if the PTT switch is slow keyed, the radio will transmit 45MHz below the selected receive frequency. The type of modulation depends on the currently selected mode.

c. Test Mode Entry

To enter the test mode, press and hold the test mode button on the RTK4079A Interface Cable until the radio gives an audible "beep" and the receiver unmutes. The "beep" will not be heard if the keypad chirp tones are currently disabled (Refer to the STX Operator Manual for muting and unmuting the keypad tones). Non-display radios will always beep, and then unmute.

If the radio does not enter the test mode, turn the radio off and back on. If pressing the test mode button again (after turning the radio off and on) does not access the test mode, the cable may not be mated to the side connector properly or there may be some other operational problem. If the STX radio has been operationally inhibited via a dynamic regrouping command or if a digital portion of the controller board has failed, the test mode cannot be entered. The "Power-Up Self Test" paragraph in this section of the manual explains these conditions.

d. Serial Number Display

When the test mode is entered, the radio serial number will be displayed on the LCD, provided that the radio is so equipped. The displayed number should match the serial number (S/N) printed on the back cover label.

The ten-digit serial number is displayed in two screens of the LCD. The first screen contains the first three digits and the second screen displays the last seven digits. The letters in the serial number are spaced on the second screen to line up with the alphanumeric locations on the LCD. Each screen is displayed only once for two seconds. The test mode must be re-entered to display the serial number again. Test mode operation is the same for radios with no LCD, except that the numbers are not displayed.

e. Software Version

After the serial number is displayed, the version number of the radio software is displayed.

f. Frequency Selection and Display

After the version number has been displayed, the receiver will be unmuted on 851.0125MHz. This is frequency number 1 of the three available fixed test frequencies listed in Table 15.

Table 15. Test Frequencies

FREQ. NO.	RECEIVE	TRANSMIT	AUDIBLE FEEDBACK
1	851.0125MHz	806.0125MHz	One beep
2	869.9875MHz	824.9875MHz	Two beeps
3	860.5125MHz	815.5125MHz	Three beeps

If the test mode is entered with the radio on a conventional system, only the above frequencies are available. If the radio is on a trunked system, and pin 31 of connector P602 (SPARE) is grounded when the test mode is entered and during the test mode, four more frequencies are available. These additional

frequencies are the customer control channel frequencies of the trunking system that the radio was on before entering the test mode. The added requirement for accessing the customer frequencies is intended to discourage unauthorized non-trunked use of those frequencies. Conventional customer frequencies are not available in the test mode; simply select that system in normal operation.

Frequencies are selected by quick-keying the PTT switch. A number of audible beeps will be sounded to indicate the frequency number. The first customer control channel frequency is indicted by four beeps, the second by five beeps, and so on. When the PTT switch is quick keyed from the last available frequency, one beep is sounded, indicating operation on frequency number 1.

Each time the test mode frequency is changed, the receive and transmit functions are set to the first mode (US). Therefore, the desired frequency should always be selected before selecting the operating mode.

Note that only the six least-significant digits of the selected frequency are displayed, followed by the operating mode identifier. For example, if the PTT switch is quick keyed and the radio advances to frequency number 2, the display would show "699875US," (US is the first receive-transmit mode) and the frequency number will be "announced" by two audible beeps.

f. Mode Selection and Display

When in the test mode, the receive-transmit function modes (US, LS, HS, CL, and D0) are sequentially selected by pressing the control button located on top of the radio. Each time the control button is pressed, the radio will chirp and advance to a new mode. When the last mode (D0) is reached, pressing the control button again will select the first mode (US). The currently selected mode is displayed as two letters on the right side of the display.

NOTE

Whenever the PTT switch is quick keyed to change frequencies, the mode is always set to US (UnSquelched).

In the LS mode, the connect tone is 105.88Hz, unless the current frequency is a customer trunking control channel frequency. Then it is the customer trunking connect tone for the system that was selected before the radio entered the test mode.

In the DTMF tone mode, the letter "d" is displayed, along with the currently selected digit. When the DTMF tone mode is entered, the initial digit is zero (0), representing tone pair "0." To change the current DTMF tone pair, the keypad is required. Press the desired digit or the (STEP) key to advance the digit. Note that the asterisk (*) and pound sign (#) are displayed as "A" and "P," respectively.

To transmit the selected DTMF tone pair, slow key the PTT switch. Whenever the PTT switch is not keyed in the DTMF tone mode, the noise squelch input is being monitored. If a received signal is detected, the receiver is unmuted; otherwise, the receiver remains muted. This mode is used for adjusting the internal **SQUELCH** potentiometer, R003.

g. Synthesizer Unlock, Low Battery, and Transmit Indications

If the synthesizer on the transceiver board does not lock (SYNTH LOCK line inactive), repeated low frequency beeps that sound like invalid keypad chirps will be generated, and the "LCK" annunciator will flash. Quick keying the PTT switch will change frequencies, but the radio will not transmit.

If the battery is low (LOW BATTERY DET line active), a "cricket" tone will be generated when the PTT switch is released and the radio stops transmitting. Also, the "BATT" annunciator will flash.

When the STX radio is transmitting (TX INDICATOR line active), the transmit annunciator (lightning bolt) will be displayed.

h. Test Mode Exit

The test mode is exited by turning the radio off. Thus, to change systems (to use customer frequencies), the radio must first be turned off.

4. TROUBLESHOOTING THE FRONT COVER ASSEMBLY

a. Non-Display Models

The most efficient and recommended method of determining whether a non-display front cover assembly is defective is by substitution.

If the trouble symptom still exists with a known good front cover assembly, check the flex connector from the controller board to the front cover assembly and the six lines on the controller board which lead to the flex connector.

b. Display Models -- Internal Test Mode

The internal test mode allows the front cover assembly to be tested independently, i.e., separated from the radio without a host processor sending commands over the SCI lines. To determine whether the front cover assembly is operating properly, proceed as follows:

Step 1. Make the connections to the keypad/display board in the sequence listed in Table 16.

Table 16.
Keypad/Display Board Test Connections

CONNECT SEQUENCE	J5 CONNECTOR		CONNECT TO:
	PIN NO.	NAME	
1	1	GND	Ground
2	5	+5VDC	+5VDC
3	6	+7.5VDC	+7.5VDC
4	2	RESET	Ground
5	4	SCI IN	+5VDC
6	3	SCI OUT	+5VDC through 100k resistor

Step 2. Reset the front cover assembly by momentarily connecting the RESET line to +5 volts, then reconnect it to ground. All display segments should

light as shown in Figure 21. If the LCD display does not look like Figure 21, replace the front cover assembly.

NOTE

At any time, the following test sequence can be restarted by connecting the RESET line to +5 volts, and then reconnecting it to ground.

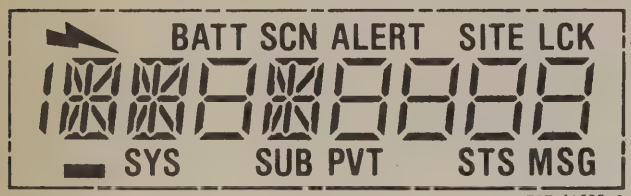


Figure 21. LCD Test Display 1

Step 3. Test the SCI input path by connecting the SCI IN line to ground, and resetting the front cover assembly as described in Step 2. All other connections remain unchanged. The LCD display should look like Figure 22. If it does not, then replace the front cover assembly.

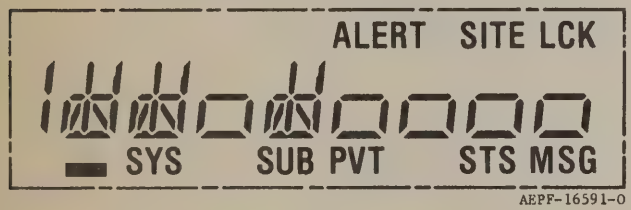


Figure 22. LCD Test Display 2

Step 4. Reconnect the SCI IN line to +5 volts, and reset the front cover assembly.

Step 5. Connect an oscilloscope to the SCI OUT line on the board side of the 100k resistor. Set the time scale on the oscilloscope to 50ms/div, the voltage scale to 1 volt/div, and the signal input coupling to DC.

Step 6. To test the SCI output path, press any key on the keypad and monitor the oscilloscope screen. The trace on the screen should toggle between +5 volts and ground several times. If the trace does not toggle, replace the front cover assembly.

Step 7. Enter the internal test mode by momentarily shorting test pads TP502 and TP503. The following events should occur:

a. The display is erased and then each segment is lit individually, until all have been turned on and off. If more than one segment turns on at the same time or if some segments do not light (refer to Figure 21), replace the front cover assembly.

b. The display is blank and the two LED backlights are on. If the display looks like Figure 23 or if both backlights do not light, replace the front cover assembly.

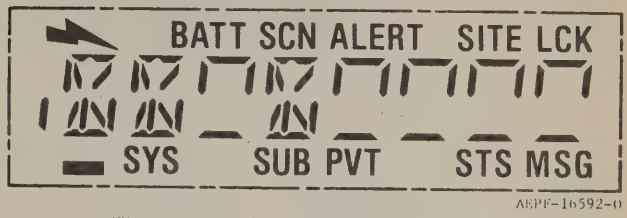


Figure 23. LCD Test Display 3

c. The LED backlights stay on and the internal test mode waits for a key to be pressed, one at a time. For as long as a key is pressed, a capital letter (A through O, depending on which key is pressed) will appear on the display in the leftmost character position. Figure 24 contains a position-letter map defining the keypad-displayed letter relationship. For a 3-key keypad, only the upper row (A,B,C) of the 15-key position-letter map will be seen. If any letter is not complete or incorrectly formed, or if extra segments are displayed, replace the front cover assembly.

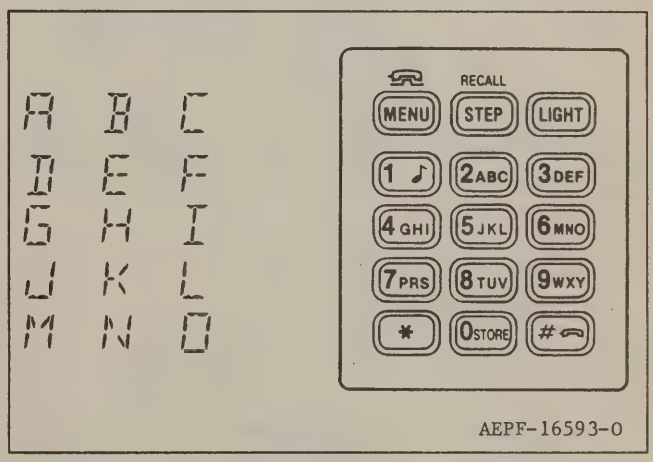


Figure 24. Key Position – Displayed Letter Map

Step 8. If the preceding tests were completed successfully (no defect indicated) and the radio still exhibits the same problem when the front cover asssembly is re-installed, the problem most likely lies in the flex connector from the controller board to the front cover assembly or in the six lines on the controller board which lead to the flex connector.

5. TROUBLESHOOTING THE TRANSCEIVER BOARD

When the performance characteristics of the radio are degraded such that a problem on the transceiver board is suspected (weak or off-frequency transmission and/or reception, distorted audio, etc.), the technician must use a logical troubleshooting procedure to relate the symptom to a specific stage of the transceiver circuitry. The information in this section of the manual provides such a procedure by presenting a step-by-step analysis of the transceiver system blocks (stages). The four basic system blocks are:

- Transmit/Receive Injection Block
- Transmitter Block
- Receiver Front End Block
- Receiver Back End Block

The first step in successful system analysis is the isolation of the problem to one of the above blocks. Understanding how all of the blocks function, and how they interact with each other, simplifies problem analysis. Each of the four blocks and their functions will be briefly described in the following paragraphs, however, a more detailed description of the circuits is contained in the Theory of Operation section of this manual.

In many instances, problems on the transceiver board can be quickly identified and isolated to a specific component by checking for the presence (or absence) of the proper ac, dc, or rf voltage levels. The voltage analysis charts, Tables 17, 18, and 19 list the voltage levels that should be obtained when the associated circuitry is operating properly. These charts are referenced throughout the troubleshooting procedure steps.

a. Transmit/Receive Injection Block

The Transmit/Receive Injection Block provides both receiver and transmitter injection, and consists of the following modules:

- U8 – Voltage Regulator (+5.0 and +4.6Vdc)
- U10 – Reference Oscillator (12.8MHz)
- U11 – Synthesizer Module
- U12 – Voltage Control Oscillator (VCO)
- U101 – Instantaneous Deviation Control (IDC)
- U102 – Frequency Multiplier (Times 2)
- U103 – Injection Filter/Switch

(1) Functional Description

The regulator module (U8) supplies +4.6Vdc and +5.0Vdc to the VCO (U12) and the synthesizer (U11), and +5.0Vdc to the 12.8MHz reference oscillator (U10). The 12.8MHz rf signal is routed to the synthesizer, where it is divided down and fed to an internal phase comparator via a fixed-frequency divider. Programmable dividers in the synthesizer (controlled by the microprocessor on the controller board) divide down the VCO feedback signal and feed it to the same phase comparator. A correction voltage is then produced by the charge pump, shifting the VCO frequency either up or down, as required.

The VCO output frequency is fed to U102, where it is doubled, and then coupled to the injection filter/switch (U103). This module filters and directs the injection signal either to the mixer module for receiver operation or to the transmit buffer for transmitter operation. The VCO output frequency ranges and the doubled injection frequency ranges are shown in Table 20.

Modulation from the controller board is applied to both the reference oscillator (U10) and the VCO (U12). An audio voltage divider (R106, R107, and R307) connects them to the modulation line. R107 affects the signal level applied to both the reference oscillator and the VCO inputs, and is used to adjust modulation sensitivity. R106 varies the level of modulation applied to the VCO, and is used to adjust modulation balance.

The IDC module (U101) is used to amplify, limit, preemphasize, and filter the microphone audio before it is sent to the controller board.

(2) Analysis Procedure 1

PROBLEM

No injection to either the receiver or transmitter, or the synthesizer is off frequency.

Step 1. Refer to the DC Voltage Analysis Chart, Table 17, and verify that the correct voltages are applied to reference oscillator U10, synthesizer U11, and VCO U12. If all of the voltages are correct, skip steps 2, 3, and 4. Proceed to Step 5.

Step 2. Refer to Table 17 and verify that the correct supply and output voltages associated with voltage regulator U8 are present.

Step 3. Inspect the circuit board for solder shorts, defective components, cold joints, or open paths. Check the dc and signal paths to the modules, using an ohmmeter.

Step 4. If no problem can be found and the regulator output is not present, replace the regulator module (U8) and recheck the injection block for proper operation.

Step 5. Using the service monitor, probe pin 2 of reference oscillator U10. If the 12.8000MHz signal is present at pin 2, skip steps 6 and 7. Proceed to Step 8.

Step 6. If no 12.8MHz signal is present, inspect the circuit board for possible shorts or defective components. Check the signal path from pin 2 of U10 to pin 6 of U11.

Table 17. DC Voltage Analysis Chart

REF. SYM.	PIN NO.	LEVEL (Vdc)	
		RX MODE	TX MODE
U1	6	0.02	7.25
U3	1	5.0	0
U5	4	4.6	4.6
U6	3	4.6	4.6
	5	2.8	2.8
	6	7.5	7.5
	15	3.8	0.10
U7	1	7.5	7.5
	12	4.6	4.6
	13	0.25	0.10
	14	7.1	7.2
	15	3.75	1-6
U8	2	4.6	4.6
	4	7.5	7.5
	6	5.0	5.0
U10	3	5.0	5.0
	7	4.2	4.2
	14	2-4.2	2-4.2
U11	2	1.0-4.0	1.0-4.0
	4	5.0	5.0
	8	4.9	4.9
	11	4.9	4.9
U12	1	4.6	4.6
	3	5.0	5.0
	4	4.6	4.6
	8	1.0-4.0	1.0-4.0
	15	5.0	5.0
	16	5.0	0(TA) / 5(RP)
U101	1	0	4.3
	4	0	4.3
U102	4	5.0	5.0
	8	4.9	4.9
U103	8	0.02	7.3
	9	4.6	4.6
U104	1	0	4.4
	3	0	3.5
U105 1-Watt	1	0	3.5
	2	0	7.4
	3	0	3-6
	4	7.5	7.4
	5	0	7.4
	6	0	7.4
	7	7.5	7.3
U105 3-Watt	1	0	3.5
	2	0	7.3
	3	0	3-6
	4	0	3-6
	5	0	7.3
	6	0	7.3
	7	7.5	7.2
U107	2	0	2-4
	3	0	4.1
	4	5.0	5.0
	7	0	4.5
	8	4.9	0.2

Conditions:

1. Radio in Test Mode US.
2. Tx measurements made with radio operating into a 50Ω load.
3. Refer to Service Manual 68P81040C25 for test configurations.

Table 18. RF Voltage Analysis Chart

REF. SYM.	PIN NO.	LEVEL (mVrms)	
		RX MODE	TX MODE
U1	2	0	See CAUTION
	5	8-11	See CAUTION
	8	8-12	---
U2	2	8.5-11	---
	13	7-10	---
U3	6	5.5-9	---
	9	30-40	---
U4	2	29-38	---
	5	28-35	---
U5	12	30-40	---
	14	20-32	---
U10	2	IV*	IV*
U11	6	IV*	IV*
	14	35-65	35-65
U12	12	80-110	80-110
	13	50-70	50-70
U102	1	110-130	110-130
	10	90-110	90-110
U103	1	85-105	85-105
	7	2-6	55-80
	11	10-25	2-12
U104	3	---	60-90
	10	---	60-80
U105	1	---	60-80
	8	---	See CAUTION

CAUTION
HIGH RF LEVEL -- USE POWER METER

*Measurement must be made with a high impedance probe or oscilloscope.

Conditions:

1. Radio in Test Mode US.
2. Frequency = 860.5125MHz.
3. Rx measurements made with a −20dBm (23mV) signal at the antenna port.
4. Tx measurements made with transmitter operating into a 50Ω load.
5. RF measurements made with RTL4208A 800MHz Probe and S1339A RF Millivolt Meter, or equivalent.
6. Refer to Service Manual 68P81040C25 for test configurations.

Table 19. AC Voltage Analysis Chart

REF. SYM.	PIN NO.	LEVEL (mVrms)	
		RX MODE	TX MODE
U6	18	20-60	---
U7	2	15-45	---
	4	20-60	---
	11	90-130	---
	13	400-600	---
	14	400-600	---
	15	2.5V-3.0V	---
U101	2	---	850
	5	---	9.5
	9	---	300

Conditions:

1. Radio in Test Mode US.
2. Frequency = 860.5125MHz.
3. Rx measurements made with a 1mV signal into antenna port, modulated by a 1000Hz tone at 3.0kHz deviation. Volume control set to maximum.
4. Tx measurements made with a 10mV, 1000Hz tone, applied to the external mic input through the RTX4005A Test Set.

Table 20.
VCO Output and Injection Signal Frequency Ranges

MODE OF OPERATION		FREQUENCY RANGES	
		VCO OUTPUT (U12, PIN 12)	INJECTION SIGNAL (U102, PIN 10)
Receive		426.5-435MHz	851-870MHz
Transmit	Repeater	403-412.5MHz	806-825MHz
	Talk-Around	426.5-435MHz	851-870MHz

Step 7. If no problem can be found, replace the reference oscillator (U10), and recheck the injection block for proper operation.

Step 8. Check the VCO control voltage at pin 8 of U12. It should be from 1.0 to 4.0 Vdc. Make certain that the 12.8MHz rf signal is present at pin 6 of U11, using the method described in Step 5. If the control voltage appears stable and is within the mentioned range, skip steps 9, 10, and 11, and proceed to Step 12.

Step 9. If the control voltage appears unstable or is not present at all, inspect for shorts on the control line and check for continuity from pin 2 of U11 to pin 8 of U12.

Step 10. Connect a variable (1 to 4-volt) supply to pin 8 of U12 through a 10k resistor.

Step 11. Using a frequency counter or monitor, check the VCO output by varying the supply voltage from 1.0 to 4.0 volts. If the frequency moves with the supply, the VCO is probably okay. Replace the synthesizer module (U11), and check for proper operation of the injection block.

Step 12. Using the service monitor, probe pin 12 of the VCO (U12). If the frequency appears stable, skip steps 13 and 14. Proceed to Step 15.

Step 13. If the frequency appears unstable or if no frequency is present, check and inspect for possible solder shorts, defective components or open circuits.

Step 14. If no problem can be found and no frequency is output from the VCO, replace the VCO module.

Step 15. Using the service monitor, check for the presence of the VCO signal at pin 1 of frequency multiplier U102. Probe pin 10 of U102 and adjust the frequency of the service monitor receiver for twice the frequency measured at pin 1. The output frequency should be between 851 and 870MHz in the receive mode. If the signal is present, skip steps 16, 17, and 18. Proceed to Step 19.

Step 16. If the signal is not present, refer to the DC Voltage Analysis Chart, and check that the voltages for U102 are incorrect.

Step 17. Check for possible shorts on the output of U102, and closely inspect the circuit board for opens, bad components, etc.

Step 18. If no problem can be found and there is no output, replace U102 and recheck for proper operation of the injection block.

Step 19. Using the service monitor, check the frequency present on pin 1 of injection filter/switch U103, then check to see if the signal level in the receive mode is approximately −15dBm at pin 11 of U103. If the signal is present and close to this level, skip steps 20, 21, and 22. Proceed to Step 23.

Step 20. If the signal is not present at pin 11, refer to the DC Voltage Analysis Chart, and check that the voltages for U103 are correct.

Step 21. Check for possible shorts on the output of U103, and closely inspect the circuit board for opens, bad components, etc.

Step 22. If no problem can be found and there is no output, replace U103 and recheck for proper operation of the injection block.

Step 23. Remove the mixer module (U5). With the unit in the receive mode and the synthesizer loaded, check the power level into the mixer module by probing the U5-pin 14 position on the circuit board. If this signal level is approximately −12dBm, skip Step 24 and proceed to Step 25.

Step 24. If the signal is not present, check for continuity from pin 11 of U103 to pin 14 of U5. Check for possible solder shorts on the circuit board.

Step 25. Key the transmitter while probing pin 10 of transmit buffer U104. Check for a power level increase at pin 10. If no signal is present or if power is low, check for possible solder shorts or open runners. If no problem can be found, replace U103 and recheck the injection block for proper operation.

(3)Analysis Procedure 2

PROBLEM
No Modulation

Step 1. With the radio in Test Mode US, apply a 1000Hz modulation signal (greater than 10mV) to pin 3 of the CVC connector, using the RTX4005A Test Set and RTK4079A Interface Cable. Key the radio and check for presence of the signal at pin 5 of J3. If signal is present, skip steps 2 and 3. Proceed to Step 4.

Step 2. Check for presence of signal at pin 5 of IDC module (U101). If present, proceed to Step 3. If not present, check R343, R303, VR210, and C102.

Step 3. Check for signal at pin 2 of U101. If present, check R105. If not present, check dc voltage at pin 1. If the voltage at pin 1 is correct, replace U101 and recheck for proper performance.

Step 4. Check for presence of signal at pin 3 of J3. If the signal is not present at pin 3, but is present at pin 5, the fault is on the controller board. Refer to the controller board troubleshooting procedures.

Step 5. Remove the external modulating signal, and put the radio in Test Mode LS. Set the transmit frequency to 815.5125MHz, and while observing the deviation on the service monitor, key the radio.

Step 6. If no modulation appears, check for presence of the signal at pin 12 of U10, using an oscilloscope. If the signal is present at pin 12, skip Step 7, and proceed to Step 8.

Step 7. Inspect the signal path for shorts, opens, and wrong or defective components (R107, C103, C104, and C310). Repair or replace if necessary, and recheck the system for proper performance.

Step 8. If there is no deviation with the injected signal present at pin 12 of the reference oscillator module (U10), check the dc voltage at pin 3. If the voltage at pin 3 is correct, replace U10 and recheck for proper performance.

Step 9. Put the radio in Test Mode HS, and key the radio. Trace the signal to pin 4 of the VCO (U12), through R107, R307, R106, and C110.

Step 10. If the signal is present at pin 4 of U12, check for correct dc voltages at pins 1, 3, and 15. If the voltages are correct, replace U12 and recheck for proper performance.

b. Transmitter Block

The transmitter block amplifies the signal received from the transmit/receive injection block to either the one-watt or three-watt level, depending on the radio model. This block consists of the following modules:

- U104 – Transmit Buffer
- U105 – RF Power Amplifier
- U107 – Automatic Level Control

(1) Functional Description

Injection is provided by the transmit/receive injection block. This signal (at the operational frequency) is applied to the input of transmit buffer U104. The output from U104 is coupled through a high-gain rf power amplifier (U105) to antenna switch U1. This power is then routed from the antenna switch to the coax on the transceiver board.

The power output from the rf final PA is maintained over varying supply voltages by the automatic level control module (U107). This module maintains a set current through the PA which, in turn, provides a relatively flat power output.

(2) Analysis Procedure

PROBLEM

Low power output or no output in transmit mode.

Step 1. Check the rf voltage at pin 10 of U104. If the rf level at pin 10 is okay, skip Steps 2 and 3. Proceed to Step 4.

Step 2. If the voltage is not present or appears low, inspect for solder shorts, opens, etc.

Step 3. If no problem can be found, confirm the injection level from the transmit/receive injection block. If this level is not present, a problem exists in the injection block. Refer to the transmit/receive injection block analysis procedure steps.

Step 4. Check for the proper dc voltage at pin 1 of U104. If this voltage is correct, proceed to Step 6.

Step 5. If the dc voltage at pin 1 of U104 is missing or incorrect, check components R352 and C339 for proper value and placement. Check the 4.4Vdc source (transmit-only).

Step 6. Measure the dc and rf levels at pin 1 of U105. If these levels are correct, proceed to Step 10.

Step 7. If either the dc or rf voltage test points are not as specified, inspect for solder shorts, opens, etc. Check Q303 and associated components. If no problem can be found, replace U104 and recheck the circuit for proper operation.

Step 8. Check the dc level at pin 3 of U105. This voltage is provided by the automatic level control module (U107). If the dc level at pin 3 is okay, proceed to Step 10.

Step 9. Check U107 and its associated components for proper operation. Check R118 and R119 for possible damage from excessive wiper travel.

CAUTION

A very high rf level is present at pin 8 of the rf final PA (U105). Use a power meter for all subsequent rf measurements.

Step 10. Check pin 8 of U105 for proper output. If the correct power level is present, skip steps 11 and 12. Proceed to Step 13.

Step 11. Refer to the dc voltage analysis charts and verify that the dc voltage levels associated with the rf final PA (U105) are present and correct. Check for shorts on the output line.

Step 12. If no problem is found, replace U105 and recheck for proper performance.

Step 13. If power is present at pin 8 of U105, inspect the signal path to antenna switch U1 for solder shorts, opens, etc.

Step 14. Confirm a low loss through the antenna switch to the coax on the radio board.

Step 15. If a high loss is found and the radio does not meet power output specifications, replace U1 and recheck the transmitter block for proper operation.

c. Receiver Front End Block

The receiver front end block provides rejection to undesired signals, while passing the desired signal. This block consists of the following modules:

- U1 – Antenna Switch
- U2 – Filter (2-Pole)
- U3 – RF Preamplifier
- U4 – Filter (4-Pole)
- U5 – First Mixer

(1) Functional Description

Received frequencies pass through antenna switch U1 to the 2-pole filter (U2), where undesired out-of-band frequencies are attenuated. Signals in the 851 to 870MHz frequency range are amplified by the rf preamplifier stage (U3) and applied to the 4-pole filter (U4). This filter provides further attenuation of undesired out-of-band signals, before the desired signal is passed to the first mixer module (U5). Here the on-channel signal is mixed with the first local oscillator injection to produce a 44.9625MHz first i-f output.

(2) Analysis Procedure

PROBLEM

Poor receiver sensitivity at either the low end or the high end of the band.

NOTE

Resistance checks on stripline filters U2 and U4 (and other connected circuits) can be misleading. Inputs and outputs are connected to ground (zero ohms).

Step 1. Remove the mixer module (U5) from the board, and apply an 851.0125MHz signal from a generator to the input coax. Adjust the level from the generator to −20dBm.

Step 2. Using the test probe with an rf millivoltmeter, check the signal level at the pin 12 position for U5 on the circuit board. The level should be a minimum of −17.2dBm.

Step 3. Change the frequency of the generator to 869.9875MHz and recheck the level at the pin 12 position. If the measured level is below −17.2dBm at either frequency, the problem is in the receiver front end. Skip Step 4 and proceed to Step 5.

Step 4. If the level measurements are above −17.2dBm at both frequency settings, the problem is in the receiver back end. Refer to the receiver back end or the mixer module itself. Skip Steps 5 through 14. Proceed to step 15.

Step 5. Refer to the dc voltage analysis chart, and check the dc voltages for antenna switch U1, rf preamp U3, and mixer U5. If the voltages are correct, skip steps 6 and 7. Proceed to Step 8.

Step 6. Inspect for solder shorts, bad components, or opens, and check the voltage at transistor Q203. Be certain that the 7.5-volt transmit voltage is not present at the base of Q203 in the receive mode. If it is, check Q103.

Step 7. Correct the defect and recheck for proper front end performance.

Step 8. Reinstall the mixer module, and inject an 851.0125MHz, −20dBm signal into the rf coax. Check the rf voltage, using a probe at pin 5 of U1. If the rf level is correct, skip Step 9 and proceed to Step 10.

Step 9. If the level is much lower than listed in the rf voltage analysis chart, inspect the coax. Replace the coax assembly, if defective, and recheck for proper receiver front end block performance.

Step 10. Inject an 869.9875MHz, −20dBm signal into the rf coax. Check the rf voltage, using a probe at pin 5 of U1. If the rf level is correct, proceed to Step 11. Otherwise, replace the coax assembly, and recheck the block for proper performance.

Step 11. Probe pin 2 of U2 to verify the correct rf levels at 851.0125MHz and 869.9875MHz. If these levels are correct, proceed to Step 12. Otherwise, replace the antenna switch (U1), and recheck the block for proper performance.

Step 12. Probe pin 6 of U3 to verify the correct rf levels at 851.0125MHz and 869.9875MHz. If these levels are correct, proceed to Step 13. Otherwise, replace the filter module (U2), and recheck the block for proper performance.

Step 13. Probe pin 2 of U4 to verify the correct rf levels at 861.0125MHz and 869.9875MHz. If these levels are correct, proceed to Step 14. Otherwise, replace the rf preamp module (U3), and recheck the block for proper performance.

Step 14. Probe pin 12 of U5 to verify the correct rf levels at 851.0125MHz and 869.9875MHz. If these levels are correct, proceed to Step 15. Otherewise, replace the filter module (U4), and recheck the block for proper performance.

Step 15. Substitute the mixer module (U5), with a known good unit and recheck receiver sensitivity at 851.0125MHz and 869.9875MHz. If receiver sensitivity is still poor, refer to the receiver back-end block analysis procedure steps.

d. Receiver Back End Block

The receiver back end block provides the required gain and selectivity at the intermediate frequencies, converts the 44.9625MHz first i-f to the 455kHz second i-f, discriminates the intelligence from the carrier, and produces an audio signal to drive the speaker. This block consists of the following modules/stages:

- FL001 – Crystal Filter
- U6 – IF/Discriminator/Squelch Module

- U7 – Audio Logic/Regulator Module (ALR)
- Q201/Q202 – Audio Driver
- Q003/Q004 – Audio Output

(1) Functional Description

The 44.9625MHz signal output from mixer module U5 is coupled through crystal filter FL001, which provides selectivity with very low loss, to a second mixer-oscillator stage contained in i-f discriminator/squelch module U6. External components L001, Y001, and R202 determine the frequency (44.5075MHz) of the second local oscillator. The two frequencies mix inside U6 to produce a 455kHz second i-f (44.9625-44.5075 = 0.455MHz).

The 455kHz second i-f signal is filtered by FL002, amplified inside U6, and filtered again by FL003. The signal is amplified once more before it is detected by a quadrature detector inside U6. Detected audio is then passed to the ALR module U7.

The squelch logic in U6 tells the controller whenever a signal level, determined by the setting of R003, is detected.

The gain stages in the ALR provide preamplification and shaping functions before the signal is applied to driver transistors Q201 and Q202. Final power amplification (500mW) is provided by power transistors Q003 and Q004. Output audio is then coupled through capacitors C013, C015, and C016 to the radio speaker.

The squelch logic in U7 responds to signals from the controller to enable or disable the audio circuits. The 4.6-volt regulator contained in the ALR module provides a regulated supply for selected stages of the radio.

(2) Analysis Procedure

PROBLEM

Poor receiver sensitivity (proper receiver front-end operation confirmed), or low or distorted audio output.

Step 1. If the problem is poor receiver sensitivity, and proper receiver front-end operation has been confirmed, proceed to step 5.

Step 2. Remove mixer module U5. Using the RTL4208A 50-ohm probe, inject a 44.9625MHz signal, and note the power required to produce 12dB SINAD. This level should be a maximum of 10 microvolts.

Step 3. If a level less than 10 microvolts is required to produce 12dB SINAD, the problem is not in the back end of the radio. Perform the receiver front-end block analysis procedure steps to identify the problem source.

Step 4. If a level greater than 10 microvolts is required to produce 12dB SINAD, a problem exists in the receiver back end. Reinstall mixer U5 and proceed to Step 5.

Step 5. Place a jumper across crystal filter FL001 (pin 1 to pin 3). If sensitivity does not improve, remove the jumper and go to Step 7.

Step 6. If sensitivity into the back end improves, the crystal filter may be open. Replace FL001 and recheck for proper back end performance.

Step 7. Examine the signal path from pin 1 of U5 through pin 9 of U6 (including diode CR002) for shorts, opens, etc. If no problem can be found, go to Step 9.

Step 8. If a defect is found, correct the problem and recheck the block for proper performance.

Step 9. Using a monitor receiver with a "sniffer" probe, sample for injection (44.5075MHz) from the second local oscillator near Y001. If second local oscillator injection is present, go to Step 11.

Step 10. If the second local oscillator signal is not present, or is off-frequency, examine the circuit for shorts, opens, etc. Check components L001, C214, Y001, and R202 for proper value and placement. If a defect is found, correct the problem and recheck for proper operation.

Step 11. Refer to the dc voltage analysis chart, and check that the dc operating voltages for U6 are correct.

Step 12. Inspect the signal path through FL002 and FL003 for solder shorts, cold joints, etc., and check the placement of quadrature coil L002.

Step 13. With a signal applied to U6, modulated at 1kHz (3kHz deviation), check for discriminator output at pin 4 of U7. If discriminator output is present, go to Step 15.

Step 14. If no problem can be found, and there is no discriminator output, replace U6 and recheck for proper operation of the block.

Step 15. Check the dc and ac voltages on the ALR module (U7).

Step 16. Confirm that there is audio output to pin 18 of connector P1.

Step 17. Check the dc and ac voltages for transistors Q201, Q202, Q003, and Q004, and inspect for shorts or opens in this area.

Step 18. Check for audio output at pin 15 of U7, and after capacitors C013, C015, and C016.

Step 19. If audio is present at pin 11 of connector J3, but the radio has no speaker audio, check the audio path in the control top for continuity.

Step 20. If no problem can be found, and there is no audio at pin 11 of connector J3, replace the ALR module (U7) and recheck for proper receiver back-end block operation.

Step 21. If a defect is found in the audio circuitry external to U7, repair or replace the defective component and recheck the performance of the receiver back-end block.

6. TROUBLESHOOT THE CONTROLLER BOARD

For troubleshooting purposes, the controller board circuitry can be split into two separate functional blocks (digital and analog), with the voltage regulation and dc distribution circuits common to both sections. The procedures outlined in this portion of the manual recommend replacement of specific components in both the digital and analog sections; however, it is assumed that the technician has confirmed that the external dc operating voltages are present before attempting the recommended repair.

These procedures take advantage of the power-up self test diagnostic routines to isolate digital problems, and the radio test mode for evaluation of the high-speed and low-speed data paths, and DTMF operation. Typical waveform illustrations are used to support the procedures where applicable.

a. Preliminary Problem Analysis

Step 1. Remove the front cover from the radio.

Step 2. Remove the controller board, and connect the battery block to the radio.

Step 3. Mount the controller board on the controller board extender, and insert the board extender into the front cover.

Step 4. Connect the extender cable to the transceiver board connector and connect the battery block to the radio.

Step 5. If the test fails or if the board is continuously resetting, indicating a problem in the digital section of the controller, refer to the "Digital Section Troubleshooting" paragraph.

NOTE

Under normal operating conditions, the STX radio generates a variety of tones that indicate the current status or operational mode. The service technician should be familiar with these tones, and be able to recognize the difference between normal operation and the different failure modes.

Step 6. If the test does not indicate a problem in the digital section, refer to the "Analog Section Troubleshooting" paragraph.

Step 7. If the radio does not operate, check the 5.0-volt regulator circuit on the controller board. If the regulated voltage is correct (5.0+/−0.1Vdc), refer to the microprocessor troubleshooting chart (Figure 25) in the "Digital Section Troubleshooting" paragraph.

b. Digital Section Troubleshooting

Table 21 lists the power-up self test tone sequences that identify specific failures on the controller board and the recommended corrective action.

NOTE

Once a problem has been localized to the digital circuitry on the controller board, refer to the STX Technician's Guide (TT406) for complete troubleshooting procedures using the R1049 milliohmmeter.

Table 21.
Power-Up Self Test Tone Sequences

TONE SEQUENCE	POSSIBLE COMPONENT FAILURE AND RECOMMENDED ACTION
One 1-kHz Beep Each Second	U402 Microprocessor (Internal RAM) Replace U402 and repeat Self Test
Two 1-kHz Beeps Each Second	U403 External RAM Refer to External RAM Troubleshooting Chart Figure 26
Three 1-kHz Beeps Each Second	U401 Gate Array (Watchdog Circuit) Replace U401 and repeat Self Test
Four 1-kHz Beeps Each Second	U402 Microprocessor (Internal ROM) Replace U402 and repeat Self Test
Five 1-kHz Beeps Each Second	U404 External ROM Replace U404 and repeat Self Test
450Hz Tone for One Second Followed by 163Hz Continuous Tone	U405 EEPROM Refer to EEPROM Troubleshooting Chart Figure 27

(1) Troubleshooting the Microprocessor (U402)

Refer to the Microprocessor Troubleshooting Chart, Figure 25. When troubleshooting, note that any of the devices, uP, UVROM, RAM, EEPROM, or gate array could have a shorted data or address bus.

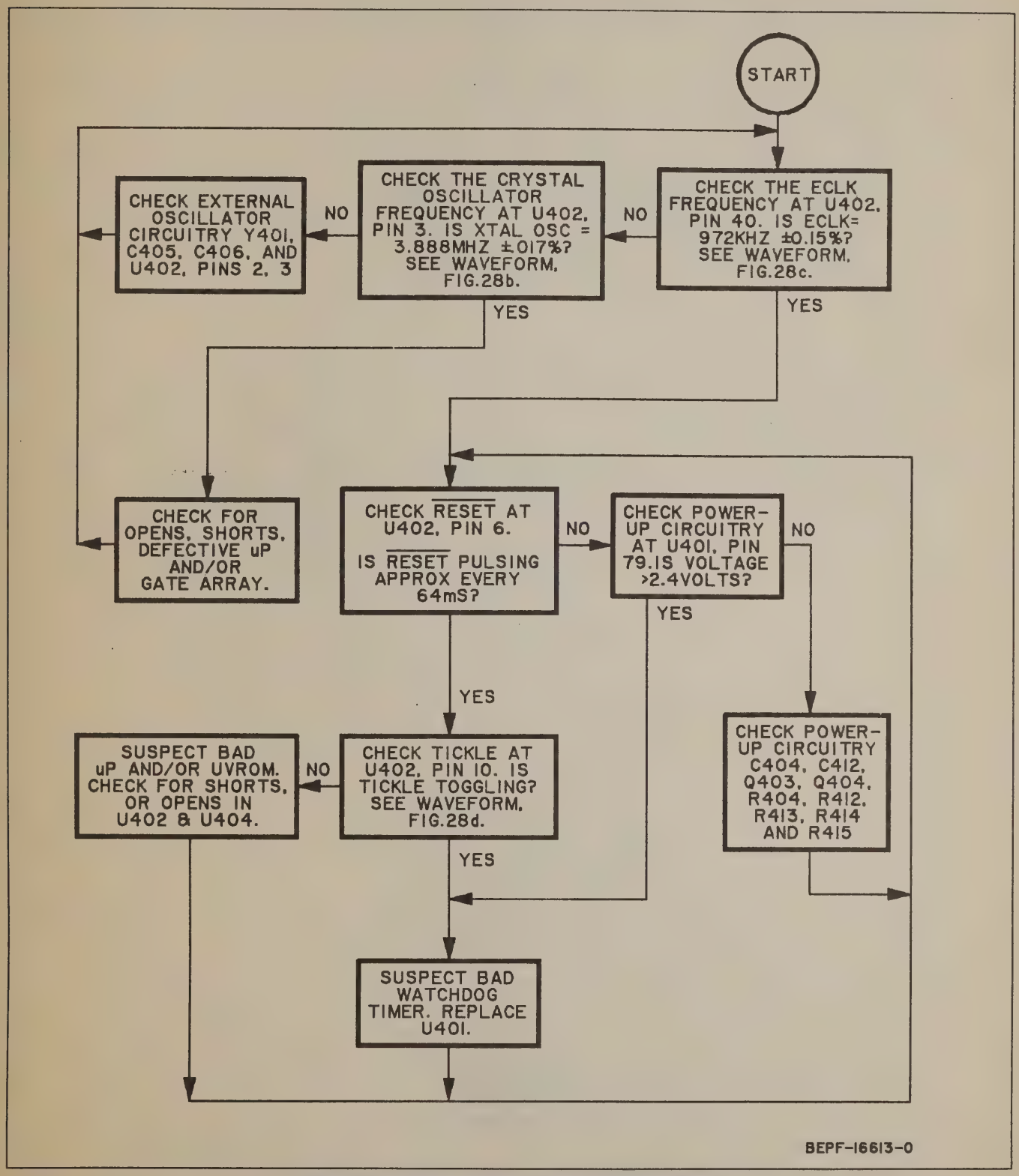

START
CHECK THE ECLK FREQUENCY AT U402, PIN 40. IS ECLK= 972KHZ ±0.15%? SEE WAVEFORM, FIG.28c.
NO
CHECK THE CRYSTAL OSCILLATOR FREQUENCY AT U402, PIN 3. IS XTAL OSC = 3.888MHZ ±.017%? SEE WAVEFORM, FIG.28b.
NO
CHECK EXTERNAL OSCILLATOR CIRCUITRY Y401, C405, C406, AND U402, PINS 2, 3
YES
YES
CHECK FOR OPENS, SHORTS, DEFECTIVE uP AND/OR GATE ARRAY.
CHECK RESET AT U402, PIN 6.
IS RESET PULSING APPROX EVERY 64mS?
NO
CHECK POWER-UP CIRCUITRY AT U401, PIN 79. IS VOLTAGE >2.4VOLTS?
NO
YES
YES
CHECK POWER-UP CIRCUITRY C404, C412, Q403, Q404, R404, R412, R413, R414 AND R415
SUSPECT BAD uP AND/OR UVROM. CHECK FOR SHORTS, OR OPENS IN U402 & U404.
NO
CHECK TICKLE AT U402, PIN 10. IS TICKLE TOGGLING? SEE WAVEFORM, FIG.28d.
YES
SUSPECT BAD WATCHDOG TIMER. REPLACE U401.
BEPF-16613-0

Figure 25. Microprocessor Troubleshooting Chart

(2)Troubleshooting the External RAM (U403)

Refer to the External RAM Troubleshooting Chart, Figure 26. Monitor R/$\overline{W}$ and $\overline{OE}$ RAM signals during radio self test (see Figure 28a).

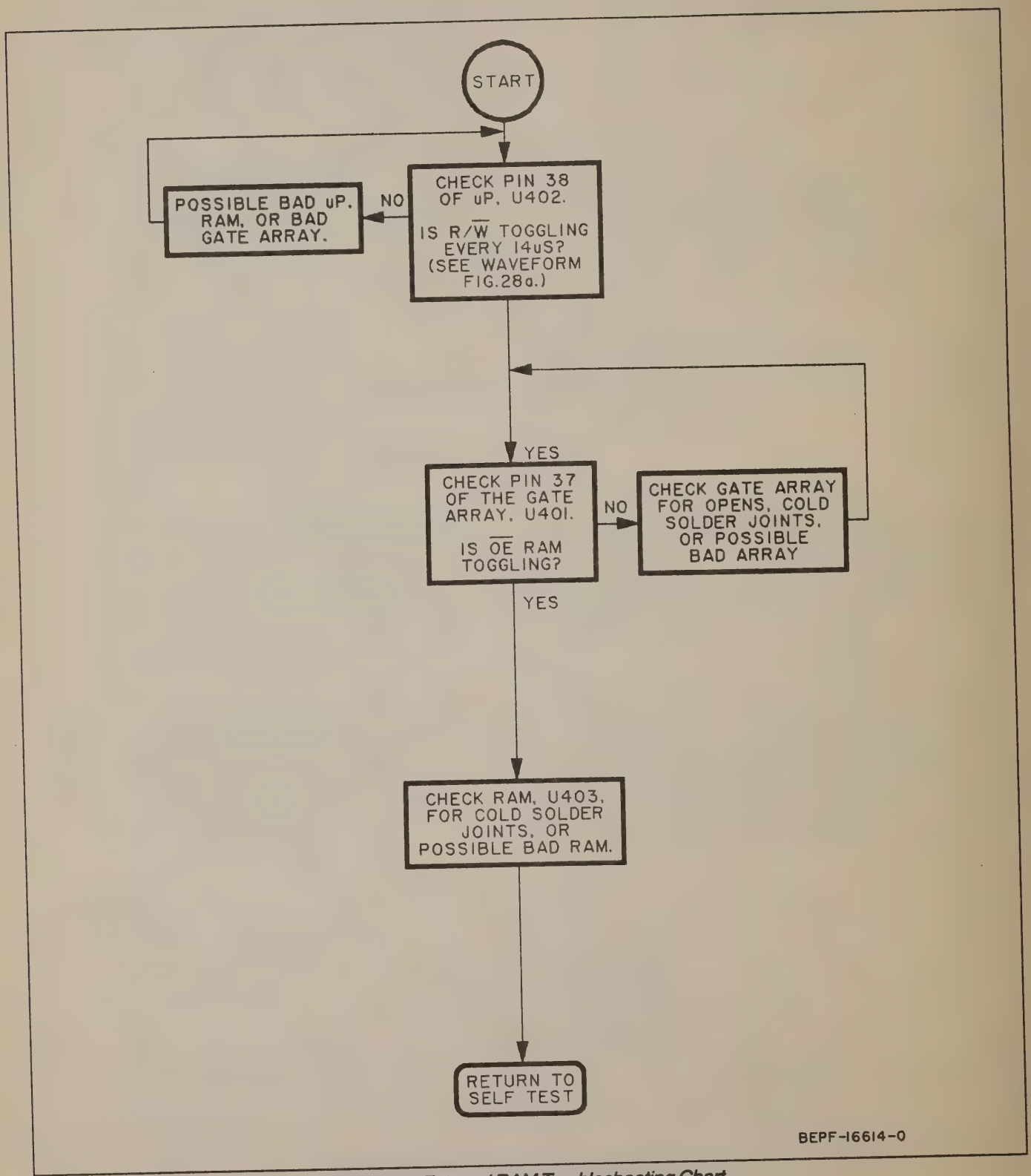

START
CHECK PIN 38 OF uP, U402.
IS R/W TOGGLING EVERY 14uS? (SEE WAVEFORM FIG.28a.)
NO
POSSIBLE BAD uP. RAM, OR BAD GATE ARRAY.
YES
CHECK PIN 37 OF THE GATE ARRAY, U401.
IS OE RAM TOGGLING?
NO
CHECK GATE ARRAY FOR OPENS, COLD SOLDER JOINTS, OR POSSIBLE BAD ARRAY
YES
CHECK RAM, U403, FOR COLD SOLDER JOINTS, OR POSSIBLE BAD RAM.
RETURN TO SELF TEST
BEPF-16614-0

Figure 26. External RAM Troubleshooting Chart

(3)Troubleshooting the EEPROM (U405)

Refer to the EEPROM Troubleshooting Chart, Figure 27. Monitor the EEPROM PWR SWITCH, $\overline{OE}$ E^2P, and $\overline{WE}$ E^2P signals during self test. It is recommended that the EEPROM be reprogrammed with customer information before replacing it with another EEPROM.

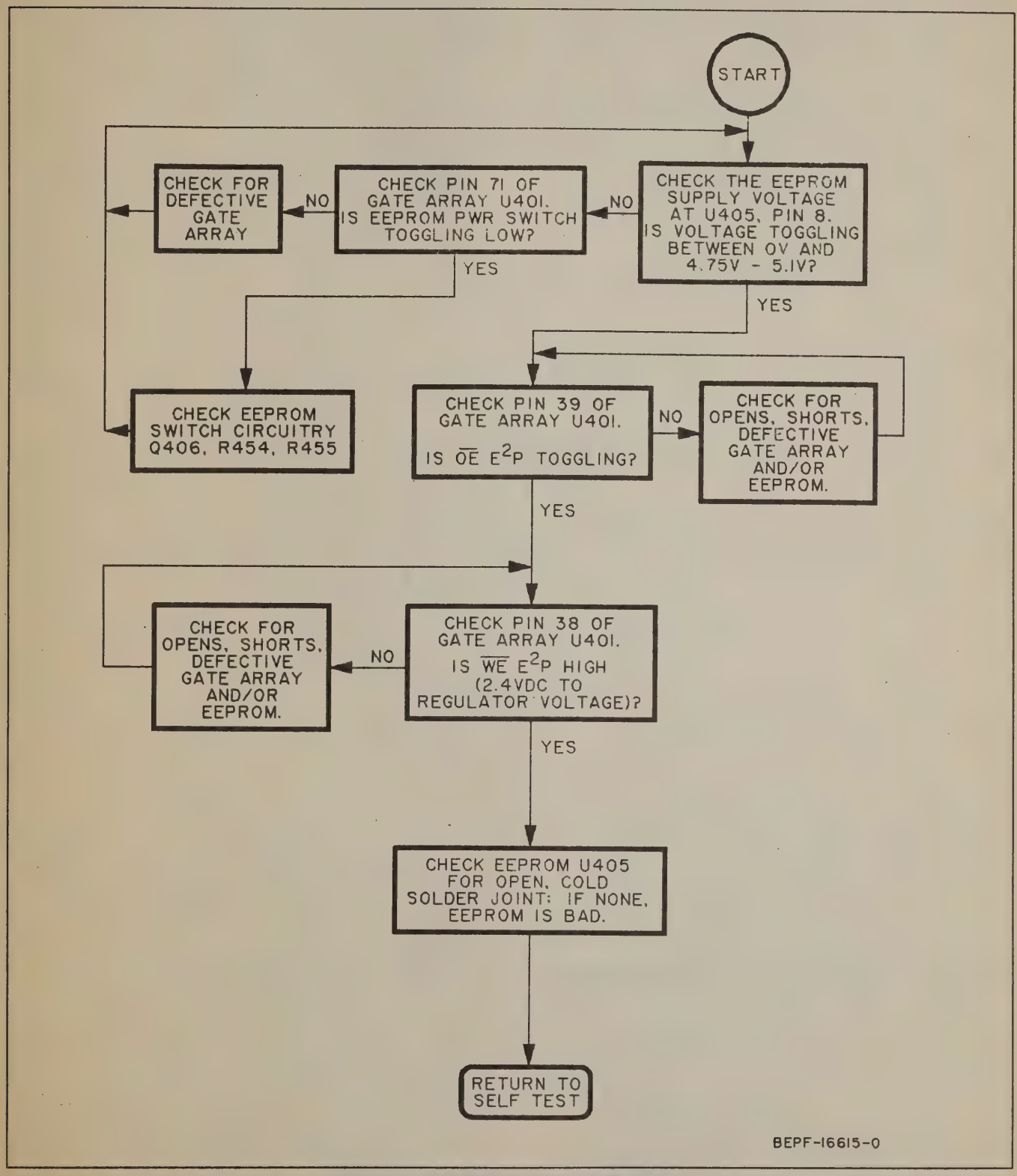
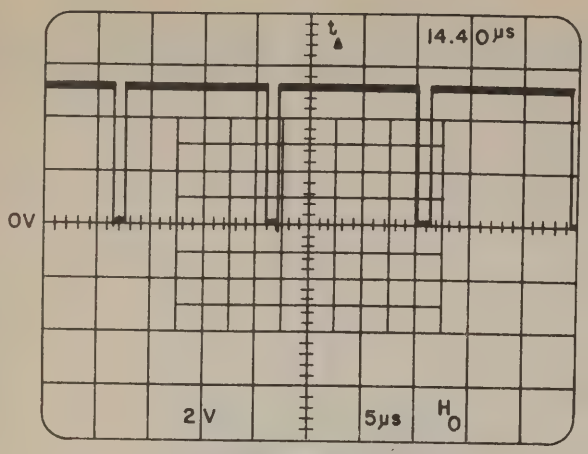
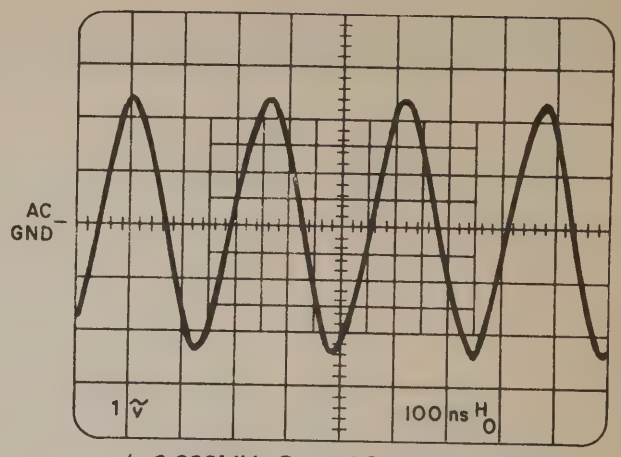

START
CHECK THE EEPROM SUPPLY VOLTAGE AT U405, PIN 8. IS VOLTAGE TOGGLING BETWEEN OV AND 4.75V - 5.1V?
NO
YES
CHECK PIN 71 OF GATE ARRAY U401. IS EEPROM PWR SWITCH TOGGLING LOW?
NO
YES
CHECK FOR DEFECTIVE GATE ARRAY
CHECK EEPROM SWITCH CIRCUITRY Q406, R454, R455
CHECK PIN 39 OF GATE ARRAY U401. IS $\overline{OE}$ E^2P TOGGLING?
NO
YES
CHECK FOR OPENS, SHORTS, DEFECTIVE GATE ARRAY AND/OR EEPROM.
CHECK PIN 38 OF GATE ARRAY U401. IS $\overline{WE}$ E^2P HIGH (2.4VDC TO REGULATOR VOLTAGE)?
NO
YES
CHECK FOR OPENS, SHORTS, DEFECTIVE GATE ARRAY AND/OR EEPROM.
CHECK EEPROM U405 FOR OPEN, COLD SOLDER JOINT: IF NONE, EEPROM IS BAD.
RETURN TO SELF TEST
BEPF-16615-0

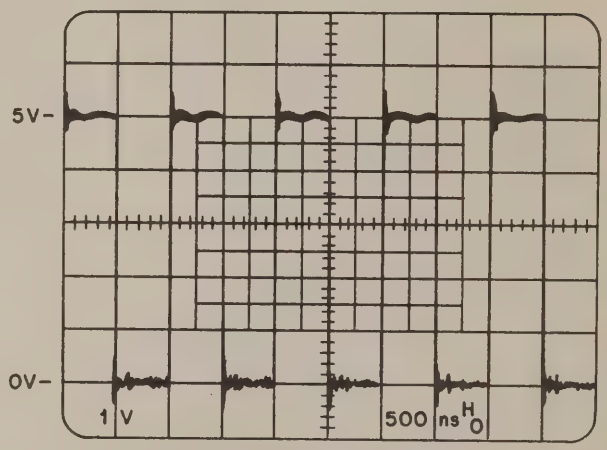
Figure 27. EEPROM Troubleshooting Chart



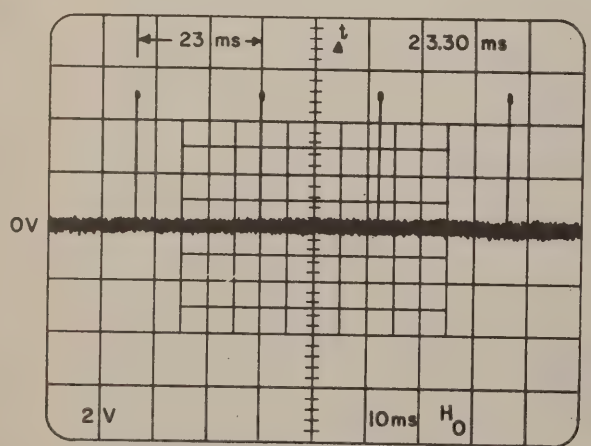
a. R/W Signal (U402-38)



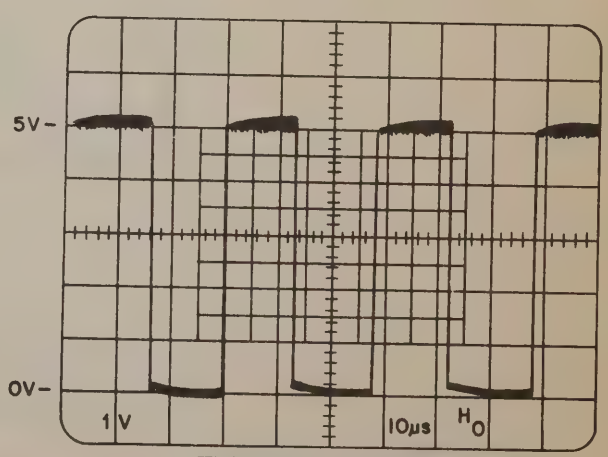
b. 3.888MHz Crystal Oscillator (U402-3)



c. 972kHz ECLK (U402-40)



d. Tickle Pulse During Normal Operation



e. Tickle Pulse During Self Test

Figure 28. Typical Microprocessor Waveforms

c. Analog Section Troubleshooting

The analog section consists of the transmit and receive, high- and low-speed data paths, the voltage regulation circuitry, and the low battery detection circuit.

The transmit and receive data paths are checked with the radio in the test mode. This mode is activated by shorting side connector pins 7 and 9 together continuously for approximately two seconds. This causes the serial data line to be grounded. To enter the test mode, press the button on the RTK4079A interface cable continuously for two seconds.

The following paragraphs describe the recommended troubleshooting procedures for checking transmit low speed, transmit high speed, receive high speed, and DTMF operation in the test mode. The STX ANALYSIS SETUP illustration contained in Service Manual 68P81049C80 shows the test equipment configuration required to properly diagnose controller problems in the test mode.

(1) Low-Speed Transmit Data Analysis Procedure

Step 1. Connect the RTX4005A Portable Set to the radio accessory side connector.

Step 2. Enter the test mode by pressing the button on the RTK4079A interface cable continuously for approximately two seconds. Once in test mode, the radio will go to carrier squelch operation and sound one 900Hz beep.

Step 3. Select the low-speed mode by pushing the orange control button, on top of the radio, once. Listen for a single 900Hz beep.

Step 4. Press PTT on the test continuously, and a 105Hz tri-stated signal (TX DATA) will be generated on pin 9 of U402.

Step 5. Check the low-speed signal level at pin 3 of connector P3 (MOD OUT).

Step 6. Refer to the Low-Speed Transmit Data Measurements Chart, Table 22, and verify the various signal connections and signal levels at the different circuit stages. Figure 29 shows the oscilloscope patterns that should be obtained.

(2)High-Speed Transmit Data Analysis Procedure

Step 1. Connect the RTX4005A Portable Set to the radio accessory side connector.

Step 2. Enter the test mode by pressing the button on the RTK4079A interface cable continuously for approximately two seconds. Once in test mode, the radio will go to carrier squelch operation and sound one 900Hz beep.

Step 3. Select the low-speed mode by pushing the orange control button, on top of the radio, twice. Listen for a 900Hz beep with each push of the button.

Step 4. Press PTT on the test continuously, and an 1800Hz square wave signal (TX DATA) will be generated on pin 9 of U402.

Step 5. Check the high-speed signal level at pin 3 of connector P3 (MOD OUT).

Step 6. Refer to the High-Speed Transmit Data Measurements Chart, Table 23, and verify the various signal connections and signal levels at the different circuit stages. Figure 29 shows the oscilloscope patterns that should be obtained.

(3)Transmit PL Tone Analysis Procedure

Step 1. Turn the radio on, and put it in the PL mode by selecting the PL system via the keypad or rotary switch. Refer to the STX operator's manual and the customer information sheet for selecting the conventional system and PL frequency. Note that the radio is not in the test mode. Not all radios will have a conventional channel with PL: only radios which are programmed for PL systems require this analysis.

Step 2. Press and hold the PTT switch (or toggle switch on the test set). The radio will generate a tri-stated PL signal. Refer to the customer information sheet for the frequency of that PL signal.

Step 3. Check the PL signal level at pin 3 of connector P3 (MOD OUT).

Step 4. Refer to the Transmit PL Tone Measurements Chart, Table 24, and verify the various signal conditions and signal levels at the different circuit stages. Figure 31 shows the expected oscilloscope patterns.

(4)Transmit DPL Data Analysis Procedure

Step 1. Turn the radio on, and put it in the DPL mode by selecting the DPL system via the keypad or rotary switch. Refer to the STX operator's manual and the customer information sheet for selecting the conventional system and DPL code. Note that the radio is not in the test mode. Not all radios will have a conventional channel with DPL: only radios which are programmed for DPL systems require this analysis.

Step 2. Press and hold the PTT switch (or toggle switch on the test set). The radio will generate a data stream similar to the oscilloscope patterns shown in Figure 32.

Step 3. Check the DPL signal level at pin 3 of connector P3 (MOD OUT).

Step 4. Refer to the Transmit DPL Tone Measurements Chart, Table 25, and verify the various signal conditions and signal levels at the different circuit stages. Figure 32 shows the oscilloscope patterns that should be obtained.

(5)Transmit DTMF Tones Analysis Procedure

Step 1. Turn the radio on, and enter the test mode.

Step 2. Select the DTMF mode by pushing the orange control button on top of the radio four times. Listen for a 900Hz beep with each press of the button.

Step 3. Enter the digit "1" via the keypad.

Step 4. Remove the front cover from the controller board.

Step 5. Press and hold the PTT switch or toggle the switch on the test set. Refer to the Transmit DTMF Tones Measurements Chart, Table 26, and verify the various conditions and signal levels at the different circuit stages. Figure 33 shows the oscilloscope patterns that should be obtained.

Step 6. Replace the front cover on the controller board and repeat steps 1 through 5, this time entering the pound sign (#) digit in step 3.

(6)High-Speed Receive Data Analysis Procedure

Step 1. Turn the radio on, and enter the test mode.

Step 2. Select the RX high-speed mode by pushing the orange control button on top of the radio twice.

Step 3. Connect the radio antenna jack to the service monitor (RF OUT), through the SMA-to-BNC rf adapter.

Step 4. Apply a 1000 microvolt 851.0125MHz signal, modulated with a 1000Hz tone at ±3kHz deviation to the radio.

Step 5. Check the RX DATA line at pin 8 of U402.

Step 6. Refer to the High-Speed Data Measurements Chart, Table 27, and verify the various signal conditions and signal levels at the different circuit stages. Figure 34 shows the oscilloscope patterns that should be obtained.

Table 22. Low-Speed Transmit Data Measurements Chart

SIGNAL NAME	MEASURED AT		LIMITS		UNITS
	REF SYM	PIN NO	MIN	MAX	
PRE-TRANSMIT ENABLE	U407	33	0.0	0.5	Vdc
RPT/TA	U406	11	4.5	5.1	Vdc
TRANSMIT PA ENABLE	U407	32	0.0	0.5	Vdc
CODED SQ	U407	3	4.5	5.1	Vdc
LOW SPEED SELECT	U407	40	0.0	0.5	Vdc
TRK/CONV SEL	U407	38	4.5	5.1	Vdc
BESSEL CLOCK (121.5k ± 0.2kHz)	U407	9	*	*	Vdc
CHEBYSHEV CLOCK (15.19k ± 0.03kHz)	U407	10	*	*	Vdc
TX DATA (105 ± 1.0Hz)	U407	13	0.60	0.73	Vpp
MOD OUT (105 ± 1.0Hz)	P3	3	0.60**	0.73**	Vpp

* Toggling between <0.5V and >4.5V.
** The amount of audio mixed with the data signal at this pin depends on the ambient room noise of the analysis area.

Table 23. High-Speed Transmit Data Measurements Chart

SIGNAL NAME	MEASURED AT		LIMITS		UNITS
	REF SYM	PIN NO	MIN	MAX	
PRE-TRANSMIT ENABLE	U407	33	0.0	0.5	Vdc
RPT/TA	U406	11	4.5	5.1	Vdc
TRANSMIT PA ENABLE	U407	32	0.0	0.5	Vdc
CODED SQ	U407	3	4.5	5.1	Vdc
LOW SPEED SELECT	U407	40	4.5	5.1	Vdc
TRK/CONV SEL	U407	38	4.5	5.1	Vdc
BESSEL CLOCK (121.5k ± 0.2kHz)	U407	9	*	*	Vdc
CHEBYSHEV CLOCK (15.19k ± 0.03kHz)	U407	10	*	*	Vdc
TX DATA (1800 ± 5.0Hz)	U407	13	1.72	2.02	Vpp
MOD OUT (1800 ± 5.0Hz)	P3	3	1.72	2.02	Vpp

* Toggling between <0.5V and >4.5V.

Table 24. Transmit PL Tone Measurements Chart

SIGNAL NAME	MEASURED AT		LIMITS		UNITS
	REF SYM	PIN NO	MIN	MAX	
PRE-TRANSMIT ENABLE	U407	33	0.0	0.5	Vdc
TRANSMIT PA ENABLE	U407	32	0.0	0.5	Vdc
CODED SQ	U407	3	4.5	5.1	Vdc
LOW SPEED SELECT	U407	40	0.0	0.5	Vdc
TRK/CONV SEL	U407	38	0.0	0.5	Vdc
PL/DPL SEL	U407	37	4.5	5.1	Vdc
BESSEL CLOCK (121.5k ± 0.2kHz)	U407	9	*	*	Vdc
CHEBYSHEV CLOCK (19.06k ± 0.03kHz)	U407	10	*	*	4.5
For a Repeater System (Refer to the Customer Information Sheet)					
RPT/TA	U406	11	4.5	5.1	Vdc
TX DATA	U407	13	0.40	0.59	Vpp
MOD OUT	P3	3	0.40**	0.59**	Vpp
For a Talkaround System (Refer to the Customer Information Sheet)					
RPT/TA	U406	11	0.0	0.5	Vdc
TX DATA	U407	13	0.40	0.59	Vpp
MOD OUT	P3	3	0.31**	0.59**	Vpp

* Toggling between <0.5V and >4.5V.
** The amount of audio mixed with the data signal at this pin depends on the ambient room noise of the analysis area.

Table 25. Transmit DPL Data Measurements Chart

SIGNAL NAME	MEASURED AT		LIMITS		UNITS
	REF SYM	PIN NO	MIN	MAX	
PRE-TRANSMIT ENABLE	U407	33	0.0	0.5	Vdc
TRANSMIT PA ENABLE	U407	32	0.0	0.5	Vdc
CODED SQ	U407	3	4.5	5.1	Vdc
LOW SPEED SELECT	U407	40	0.0	0.5	Vdc
TRK/CONV SEL	U407	38	0.0	0.5	Vdc
PL/DPL SEL	U407	37	0.0	0.5	Vdc
BESSEL CLOCK (8.17k ± 0.02kHz)	U407	9	*	*	Vdc
CHEBYSHEV CLOCK (138.86k ± 0.21kHz)	U407	10	*	*	Vdc
For a Repeater System (Refer to the Customer Information Sheet)					
RPT/TA	U406	11	4.5	5.1	Vdc
TX DATA	U407	13	0.40	0.59	Vpp
MOD OUT	P3	3	0.40**	0.59**	Vpp
For a Talkaround System (Refer to the Customer Information Sheet)					
RPT/TA	U406	11	0.0	0.5	Vdc
TX DATA	U407	13	0.40	0.59	Vpp
MOD OUT	P3	3	0.31**	0.59**	Vpp

* Toggling between <0.5V and >4.5V.
** The amount of audio mixed with the data signal at this pin depends on the ambient room noise of the analysis area.

Table 26. Transmit DTMF Tone Measurements Chart

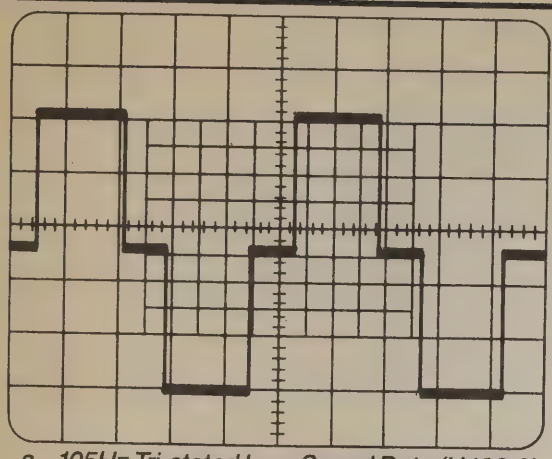
SIGNAL NAME		MEASURED AT		LIMITS		UNITS
		REF SYM	PIN NO	MIN	MAX	
PRE-TRANSMIT ENABLE		U407	33	0.0	0.5	Vdc
RPT/TA		U406	11	4.5	5.1	Vdc
TRANSMIT PA ENABLE		U407	32	0.0	0.5	Vdc
CODED SQ		U407	3	4.5	5.1	Vdc
LOW SPEED SELECT		U407	40	4.5	5.1	Vdc
TRK/CONV SEL		U407	38	4.5	5.1	Vdc
BESSEL CLOCK (121.5k ± 0.2kHz)		U407	9	*	*	Vdc
CHEBYSHEV CLOCK (15.19k ± 0.03kHz)		U407	10	*	*	Vdc
DIGIT 1	GROUP A/B SEL LOW GROUP (697Hz ± 2%)	U407	17	0.0	0.5	Vdc
DIGIT #	HIGH GROUP (1209Hz ± 2%)	P3	3			Vpp
	GROUP A/B SEL LOW GROUP (941Hz ± 2%	U407	17	4.5	5.1	Vdc
	HIGH GROUP (1477Hz ± 2%)	P3	3			Vpp

* Toggling between <0.5V and >4.5V.

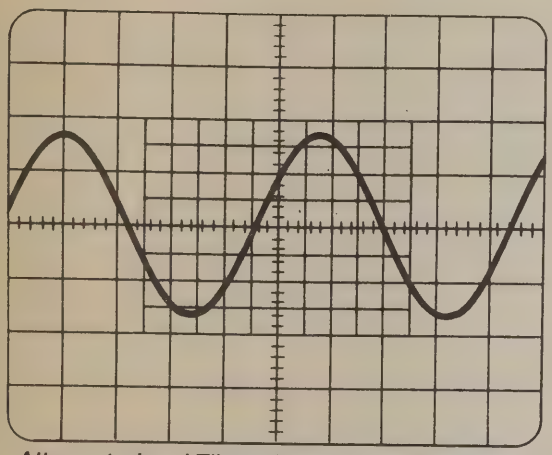
Table 27. High-Speed Receive Data Measurements Chart

SIGNAL NAME	MEASURED AT		LIMITS		UNITS
	REF SYM	PIN NO	MIN	MAX	
PRE-TRANSMIT ENABLE	U407	33	4.5	5.1	Vdc
LOW SPEED SELECT	U407	40	4.5	5.1	Vdc
TRK/CONV SEL	U407	38	4.5	5.1	Vdc
BESSEL CLOCK (121.5k ± 0.2kHz)	U407	9	*	*	Vdc
CHEBYSHEV CLOCK (15.19k ± 0.03kHz)	U407	10	*	*	Vdc
BUFFERED DISC OUT (1kHz)	P3	4	180	190	Vpp
MOD OUT (1kHz)	P3	3	*	*	Vdc

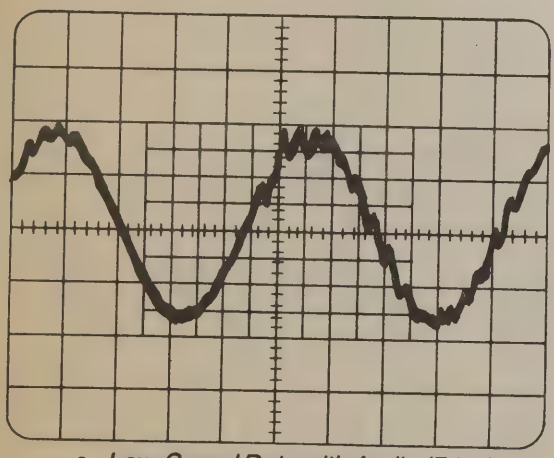
* Toggling between <0.5V and >4.5V.
** The amount of audio mixed with the data signal at this pin depends on the ambient room noise of the analysis area.



a. 105Hz Tri-stated Low-Speed Data (U402-9)

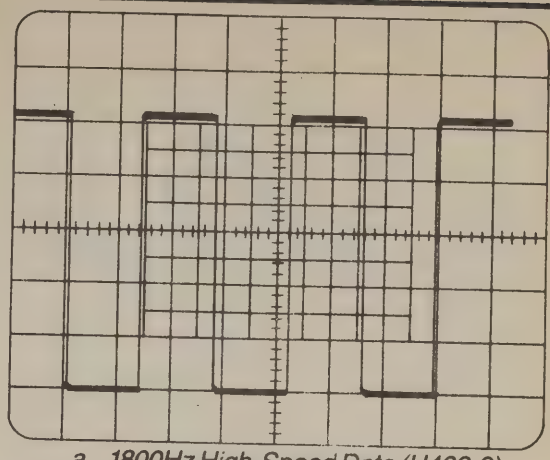


b. Attenuated and Filtered Low-Speed Data (U407-13)

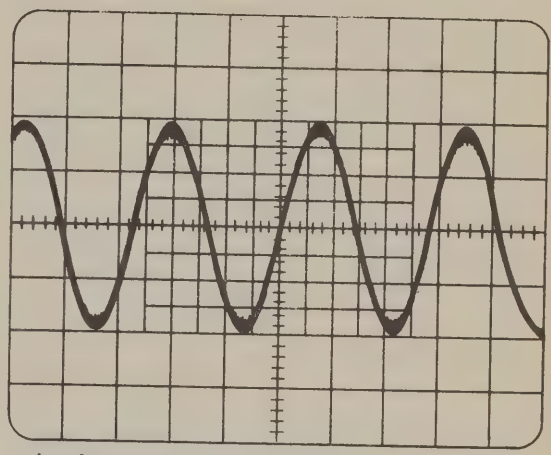


c. Low-Speed Data with Audio (P3-3)

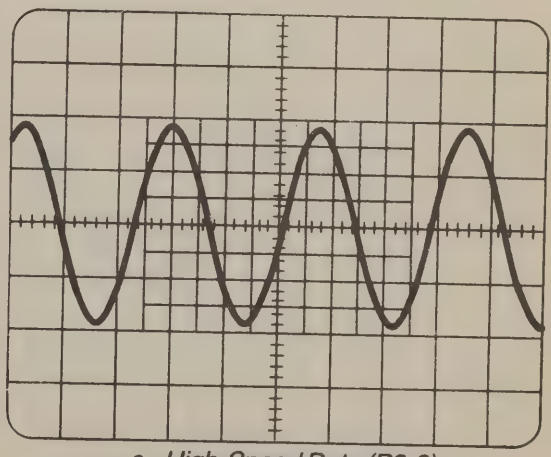
Figure 29.
Low-Speed Transmit Data - Typical Waveforms



a. 1800Hz High-Speed Data (U402-9)

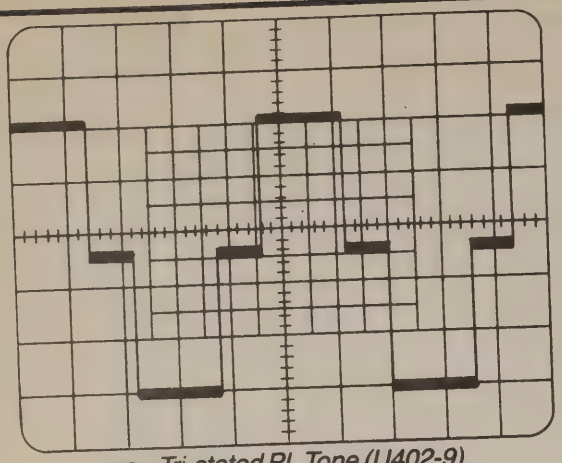


b. Attenuated and Filtered High-Speed Data (U407-13)

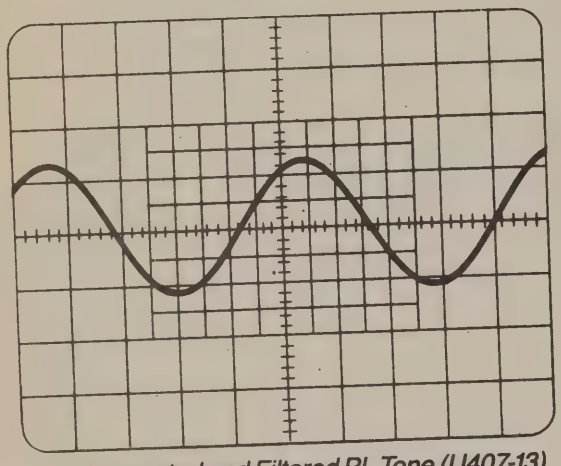


c. High-Speed Data (P3-3)

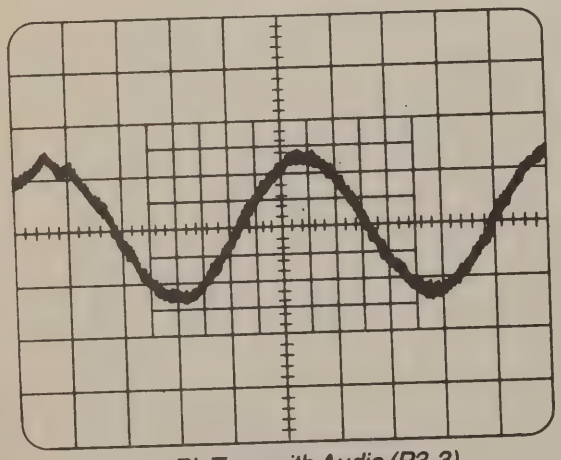
Figure 30.
High-Speed Transmit Data - Typical Waveforms



a. Tri-stated PL Tone (U402-9)

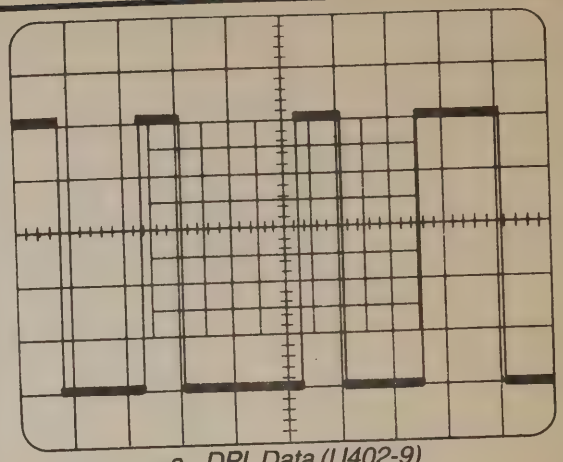


b. Attenuated and Filtered PL Tone (U407-13)

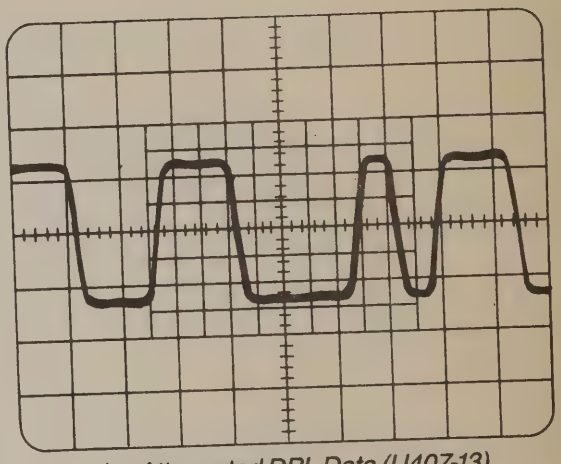


c. PL Tone with Audio (P3-3)

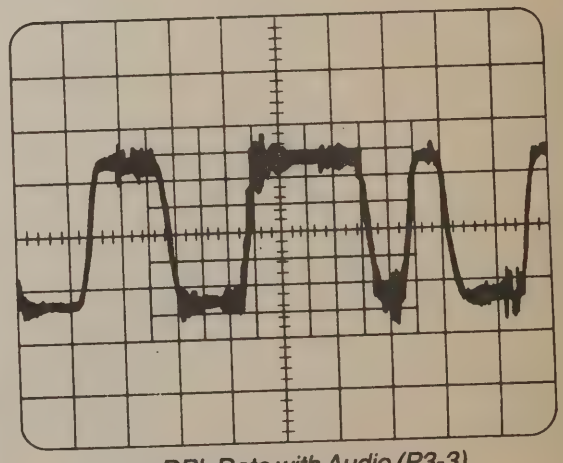
Figure 31.
Transmit PL Tone - Typical Waveforms



a. DPL Data (U402-9)

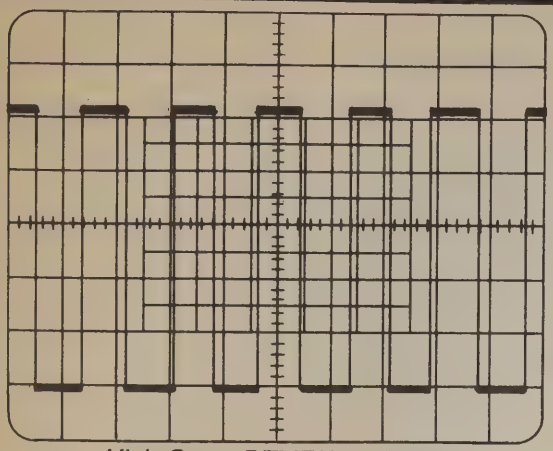


b. Attenuated DPL Data (U407-13)

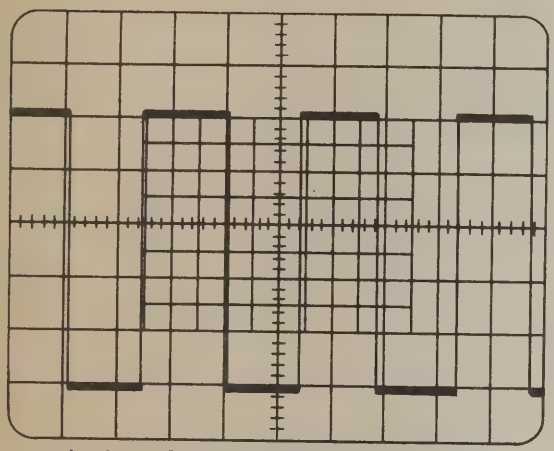


c. DPL Data with Audio (P3-3)

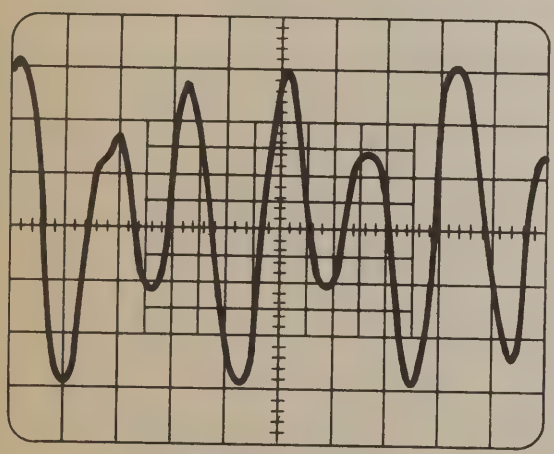
Figure 32.
Transmit DPL Tone - Typical Waveforms



a. High-Group DTMF Tone (U402-9)

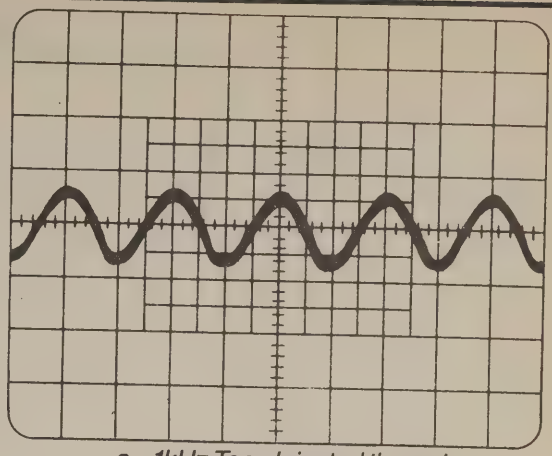


b. Low-Group DTMF Tone (U402-20)

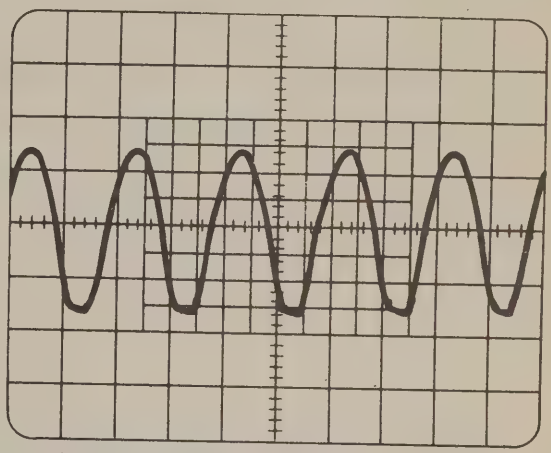


c. DTMF Tone (P3-3)

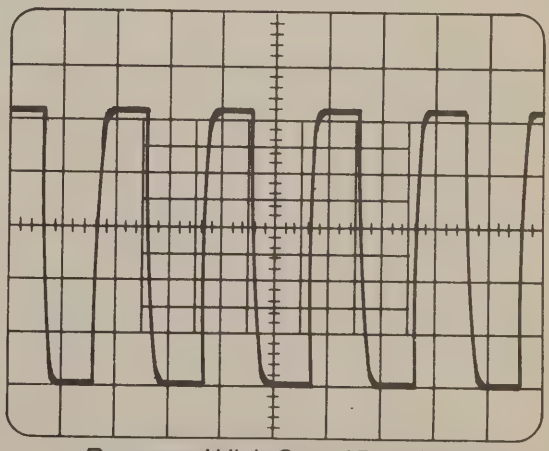
Figure 33.
Transmit DTMF Tones - Typical Waveforms



a. 1kHz Tone Injected through Antenna Jack (P3-2)



b. RX Amplified High-Speed Data (P3-4)



c. Recovered High-Speed Data (U402-8)

Figure 34.
High-Speed Receive Data - Typical Waveforms

NOTES

MANUAL
USER QUESTIONNAIRE

We believe that reports from users provide valuable information for producing good service manuals. Your answers and comments on the following questionnaire will aid us in writing manuals that contain information of maximum benefit to you.

In reference to Manual No. 68P_____

DIAGRAMS (indicate diagram number/description) _____

_____

☐ Are adequate

FOLD DOWN ALONG DOTTED LINE

☐ Are too small ☐ too big

☐ Should contain the following additional information: _____

_____

☐ Contain the following errors: _____

_____

PARTS LIST

☐ Are adequate

☐ The following information is incorrect or should be added: _____

_____

☐ I prefer exploded views for parts identification

THEORY/TROUBLESHOOTING INFORMATION

FOLD UP ALONG DOTTED LINE

☐ I use troubleshooting charts frequently.

☐ I do not use troubleshooting charts.

☐ I prefer tabular symptom/remedy charts.

☐ The following information should be added (or corrected): _____

_____

MODEL CHARTS

☐ I use charts to determine if manual is applicable to my radio model.

☐ I use the charts to determine content of model or identify what chassis/ kits are in the model; or: _____

_____

☐ I do not use these charts.

PRINTED CIRCUIT BOARD DETAILS EPF-10124-C

☐ I use printed circuit details for component location only.

☐ In addition to component location, I use printed circuit details for: _____

_____

☐ I prefer photographs/drawings with call-outs for component location purposes.

☐ Different shades of gray are adequate for double-sided boards.

☐ I prefer use of different colors for double-sided boards.

SERVICE MANUALS

(With mailer card for ordering the companion Theory/Maintenance manual)

☐ 1. Are useful service tools.

☐ 2. Should also include _____

_____

☐ 3. Response time to mailer card requests for companion Theory/Maintenance manual is: OK ☐ Too Long ☐ Days _____

OTHER COMMENTS

_____

_____

My name is _____

Company _____

Address _____

City/State/Zip _____

Phone no. (include area code) _____

PLEASE USE TAPE TO SEAL
POSTAL REGULATIONS PROHIBIT USE OF STAPLES

Please fold carefully so that bar pattern can be used by postal service optical scanner equipment

No Postage Stamp Necessary if Mailed in the United States

BUSINESS REPLY MAIL

First Class Permit No. 9040 Ft. Lauderdale, FL

Postage Will Be Paid by

MOTOROLA, INC.
Attn: Technical Publications Dept.
8000 W. Sunrise Boulevard
Ft. Lauderdale, Florida 33322

REPLACEMENT PARTS ORDERING

ORDERING INFORMATION

Motorola's Communications Parts organization maintains a number of area parts offices conveniently located throughout the United States. These facilities are staffed to process parts orders, identify part numbers, and otherwise assist in the maintenance and repair of Motorola communications products.

When ordering replacement parts, the complete Motorola part number listed in the service manual should be used. If the component part number is not known, the order should include the model number of the parent unit and sufficient description of the desired component to help identify it.

All orders should be sent to the nearest Area Parts Office, except for certain frequency-sensitive parts.

Orders for replacement crystals, channel elements, active filters, and resonant reeds, should be sent to the Component Product Sales & Service address listed below. Crystal and channel element orders should specify the crystal or channel element type number, crystal and carrier frequencies, and the model number in which the part is used. Active filter and resonant reed orders should specify type number and frequency, plus identify the owner/operator of the communications system in which these items are to be used.

COMPONENT PRODUCT SALES & SERVICE OFFICE

All Mail Orders
Motorola, Inc.
Component Product Sales & Service
P.O. Box 66191, O'Hare International Airport
Chicago, IL 60666

Correspondence
Motorola, Inc.
Component Product Sales & Service
2553 N. Edgington Street, Franklin Park, IL 60131
Tel: 312-451-1297, TWX: 910-227-0799, Telex: 433-0067

AREA PARTS OFFICES

Western Area Parts
1170 Chess Drive, Foster City, CA 94404
Tel: 415-349-8621, TWX: 910-375-3877

Pacific-Southwestern Area Parts
P.O. Box 85036, San Diego, CA 92138
Street Address:
9980 Carroll Canyon Road, San Diego, CA 92131
Tel: 619-578-8030, TWX: 910-335-1516

Gulf States Area Parts
P.O. Box 73115, 1140 Cypress Station, Houston, TX 77090
Tel: 713-537-3636, TWX: 910-881-6392

Southwestern Area Parts
P.O. Box 34290, 3320 Belt Line Road, Dallas, TX 75234
Tel: 214-620-8511, TWX: 910-860-5505

Midwest Area Parts
1313 E. Algonquin Rd., Schaumburg, IL 60196
Tel: 312-576-7430, TWX: 910-693-0869

Southeastern Area Parts
P.O. Box 368, Decatur, GA 30031
Street Address:
5096 Panola Industrial Blvd., Decatur, GA 30032
Tel: 404-987-2232, TWX: 810-766-0876

Rocky Mountain Area Parts
20 Inverness Place East, Englewood, CO 80112
Tel: 303-790-2323, TWX: 910-935-0785

East Central Area Parts
12955 Snow Road, Parma, OH 44130
Tel: 216-433-1560, TWX: 810-427-9424

Eastern Area Parts
85 Harristown Road, Glen Rock, NJ 07452
Tel: 201-447-4000, TWX: 710-988-5614

Mid-Atlantic Area Parts
7230 Parkway Drive, Hanover, MD 21076
Tel: 301-796-8763, TWX: 710-862-1941

National Accounts
Railroads, Airlines, and Telephone Sales
1313 E. Algonquin Rd., Schaumburg, IL 60196
Tel: 312-576-6512, TWX: 910-693-0869

All Canadian Orders
Motorola, Ltd., National Parts Department
3125 Steeles, Ave. E., Willowdale, Ontario M2H 2H6
Tel: 416-499-1441, TWX: 610-491-1032,
Telex: 06-526258

National Data Services

1711 West 17th Street, Tempe, AZ 85281
Tel: 602-994-6472, TWX: 910-951-1334

All Countries Except U.S. & Canada

Motorola, Inc., International Parts Department
1313 E. Algonquin Rd., Schaumburg, IL 60196. U.S.A.
Tel: 312-576-7241, TWX: 910-693-0869
Telex: 722443, Cable: MOTOL PARTS

68P81049C75-O

"STX" SERIES

"Handie-Talkie"
Trunked Portable Radios

MOTOROLA

"STX" SERIES

"Handie-Talkie" Portable Radio

806-825 MHz
851-870 MHz

SPECIFICATIONS

GENERAL		RECEIVER		TRANSMITTER	
FCC Designation:	AZ489FT5644 (1W) AZ489FT5645 (3W)	**Frequency Range:**	851-870MHz	**RF Power (No degradation):** **Over Entire Freq. Range):**	(H25)–1Watt (H35)–3Watts
Power Supply:	Nickel-Cadmium Battery	**Bandwidth (No Degradation):**	19MHz	**Frequency Range:**	806-825 and 851-870MHz
Battery Voltage:		**Quieting Sensitivity (20dBQ):**	0.5uV Max.	**Freq. Stability (−30 to +60°C; 25°C ref.):**	±.00025%
Nominal:	7.5 Volts	**Usable Sensitivity (12dB SINAD):**	0.35uV Max.	**Emission (Conducted and Radiated):**	
Range:	6 to 9 Volts	**Intermodulation:**	−60dB	**Harmonic:**	−43dBw
Temperature Range:		**Selectivity (25kHz Adjacent Channel):**	−60dB	**Spurious:**	−51dBw
Operating:	−30°C to +60°C	**Spurious Rejection:**	−60dB	**FM Hum and Noise (Companion Receiver):**	−40dB
Storage:	−40°C to +85°C	**(Except ½ IF):**	−50dB	**Distortion:**	5% Max.
Duty Cycle (5-5-90):		**Usable Bandwidth:**	5kHz Min.	**Modulation Limiting:**	±5kHz
Medium Cap. Battery:	(1W) − 8 Hours	**Freq. Stability (−30 + 60°C; 25°C reference):**	±.00032%	**Time-Out-Timer (Default):**	60 seconds
High Cap. Battery:	(1W) − 12 Hours (3W) − 8 Hours	**Rated Audio:**	500mW	**Current Drain:**	
Dimensions (H × W × D)		**Distortion (At Rated Audio):**	8% Max.	**1 Watt Unit:**	800mA
Less Battery:	4.98″ × 2.86″ × 1.49″ (12.5 × 7.3 × 3.8cm)	**Channel Spacing:**	25kHz	**3 Watt Unit:**	2025mA
With Medium Cap. Battery	7.31″ × 2.86″ × 1.49″ (18.6 × 7.3 × 3.8cm)	**Current Drain:**		**Recommended Battery:**	
With High Cap. Battery	8.65″ × 2.86″ × 1.49″ 22.0 × 7.3 × 3.8cm)	**Standby (With Display):**	60mA Max.	**1 Watt Unit:**	Med. Cap. NTN4326 or High Cap. NTN4327
Weight:		**Receive (At Rated Audio):**	180mA Max.	**3 Watt Unit:**	High Cap. Only, NTN4327
Less Battery:	17.2oz. (488g)				
With Medium Cap. Battery	28.0oz. (794g)				
With High Cap. Battery	32.0oz. (907g)				

Specifications Subject To Change Without Notice

RELATED PUBLICATIONS AVAILABLE SEPARATELY

Operator's Manual – Privacy Plus	68P81049C85
Operator's Manual – Smartnet	68P81049C90
N1352A "Converta-Com" Instruction Manual	68P81041C65
N1352A Operating Instructions	68P81041C95
N1353A Power Amplifier	68P81042C20
NMF6001B Public Safety Microphone	68P81106C20
MNM4339B and NMN6115B Remote Speaker/Microphones	68P81106C81
Theory/Maintenance Manual	68P81049C75

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Service Manual
68P81049C80-O

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MODEL CONFIGURATION

Radio Model	Power Level	Orange Control Button*			Rotary Knob+		Display and Key Pad†						Key Pad (12 Key) Without Display
		Emerg.	Phone	Vol. Set	System Select Trac-Mode (Numbered Escutcheon)	Subfleet Select (Lettered Escutcheon)	Call Alert	Private Line	Phone W/Auto Dial	Dynamic Regrouping	(Repeater And/Or Talk-Around)	Subfleet Scan	Phone
H25JNB5170CN	1 Watt	N/A	•	•	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	•
H35JNB5170CN	3 Watt												
H25JNC5170CN	1 Watt	N/A	•	•	N/A	N/A	•	•	•	N/A	N/A	N/A	N/A
H35JNC5170CN	3 Watt												
H25STC5170CN	1 Watt	•	•	•	N/A	N/A	•	•	•	•	•	•	N/A
H35STC5170CN	3 Watt												
H25STD5170CN	1 Watt	•	•	•	• 2, 8 or 16 pos.	• 2, 8 or 16 pos.	N/A	N/A	N/A	•	•	N/A	N/A
H35STD5170CN	3 Watt												
H25STE5170CN	1 Watt	•	•	•	N/A	• 2, 8 or 16 pos.	•	•	•	•	•	•	N/A
H35STE5170CN	3 Watt												

*"PHONE and VOLUME SET" are incompatible with "EMERGENCY."
+Only one rotary selector switch per radio.
†Display radios come with 3-key front cover. 15-key front cover can be added by ordering phone.

SAFETY INFORMATION

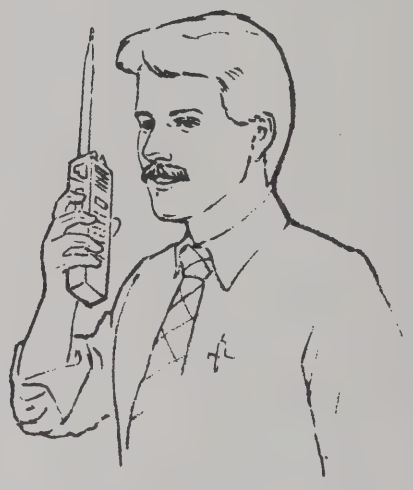
The United States Department of Labor, through the provisions of the Occupational Safety and Health Act of 1970 (OSHA), has established an electromagnetic energy safety standard which applies to the use of this equipment. Proper use of this radio will result in exposure below the OSHA limit.

DO NOT hold the radio such that the antenna is very close to, or touching, exposed parts of the body, especially the face or eyes, while transmitting. The radio will perform best if the microphone is two or three inches away from the lips and the radio is vertical.

DO NOT hold the transmit (PTT) switch on when not actually desiring to transmit.

DO NOT allow children to play with any radio equipment containing a transmitter.

DO NOT operate a portable transmitter near unshielded electrical blasting caps or in an explosive atmosphere unless it is a type especially qualified for such use.



TEPF-11861

FCC REGULATIONS

State that:

1. The rf power output of a radio transmitter shall be no more than that required for satisfactory technical operation considering the area to be covered and the local conditions.
2. Frequency and deviation of a transmitter must be checked before it is placed in service and rechecked once each year thereafter.

TEPF-13027

FCC DESIGNATIONS

AZ489FT5644 ..... 1 Watt Models

AZ489FT5645 ..... 3 Watt Models

FOLD DOWN ALONG DOTTED LINE

REQUEST FOR MAINTENANCE MANUAL

Mail within 30 days of receipt of equipment for free manual.

MANUAL NUMBER

68P81049C75

PLEASE PRINT
NAME AND
ADDRESS
CLEARLY

FOLD UP ALONG DOTTED LINE

CUT ALONG DOTTED LINE

DISASSEMBLY/REASSEMBLY

1. Turn off the radio.
2. While pushing the spring-loaded battery latch towards the top of the radio, slide the battery off away from the latch.
3. Loosen the two larger captive screws on the bottom of the radio. Do not completely remove the captive screws.
4. Pull the lower housing off the control-top housing to access the board/shield assembly.
5. Loosen the two captive screws holding the control-top housing to the board/shield assembly. Do not completely remove the captive screws.
6. Pull the control-top housing assembly from the board-shield assembly.
7. Disconnect the coaxial cable from the board/shield assembly.
8. Loosen the four captive screws holding the rear shield and remove the rear shield. Do not completely remove the captive screws from the rear shield.

CAUTION

REFER TO "SAFE HANDLING OF CMOS DEVICES"

9. Disengage the flex circuit from the front shield.
10. Slide the controller board out of the board-edge connector.
11. Remove the snap-on shield behind the controller board to access the solder side of the transceiver board.
12. Remove the snap-on front shield to access the component side of the transceiver board. Disconnect the speaker/mic cable from the transceiver board.
13. Remove the two screws inside the front of the lower radio housing to remove the front cover.

NOTE

REFER TO EXPLODED VIEW DIAGRAM IF FURTHER DISASSEMBLY IS NECESSARY.

Reassemble the radio in the reverse order of disassembly, making certain:

- to avoid pinching the speaker/mic cable between the frame and the shield.
- to avoid damage to the 28-pin board-edge connector on the transceiver board
- not to depress the PTT switch while replacing the board/shield assembly.
- to use new o-rings on the control-top and the front cover.
- to observe proper screw torque specifications per the chart below.

TORQUE SPECIFICATIONS FOR REASSEMBLY

Lower Housing to Frame (Exploded View item No.11)	4 in. lbs.
Upper Housing to Frame (Exploded View item No. 3)	3 in. lbs.
Rear Shield to Frame (Exploded View item Nos. 54, 55)	2 in. lbs.
Front Cover to Lower Housing (Exploded View item No. 73)	2 in. lbs.
Battery Contacts to Lower Housing (Exploded View item No. 17)	3 in. lbs.

(**NOTE:** If battery contact screws are not torqued properly and screws work loose, a low battery alert may occur)

RADIO INFORMATION SHEET

Two Customer Information Sheets are included with each radio; one for the service technician and one for the operator.
These sheets contain the radio's systems, channels of operation (frequency), type of coded squelch, fleets, subfleets, I.D.'s and other features.
A radio information instruction sheet is provided on the reverse side.
The radio unit's serial number appears at the top of the information sheet.
A sample information sheet and a copy of the radio information instruction sheet are shown on next page.

RADIO INFORMATION INSTRUCTION SHEET

IMPORTANT

RADIO INFORMATION INSTRUCTION SHEET

THIS INFORMATION IS NEEDED FOR SERVICING
DO NOT DESTROY

INSTRUCTIONS

THE RADIO INFORMATION SHEET ON THE REVERSE SIDE CONTAINS THE SPECIFIC DATA THE FACTORY HAS PROGRAMMED INTO THE UNIT.

EACH FIELD OF THE SHEET IS EXPLAINED BELOW:

①	**MODEL**	– MODEL NUMBER DESIGNATION OF THE UNIT
②	**SERIAL NUMBER**	– SERIAL NUMBER OF THE UNIT AND MINIMUM REQUIRED VERSION NUMBER
③	**DATE**	– PRINTING DATE OF THE RADIO INFORMATION SHEET
④	**SYS**	– ROTARY SWITCH OR DISPLAY NUMBER POSITION OF THE SYSTEM IN MULTIPLE SYSTEM UNITS
⑤	**RADIO OPTIONS**	– RADIO OPTION NUMBERS IN EFFECT FOR ALL SYSTEMS IN THE UNIT

EXAMPLE: ① MODEL: H25STC5150BN ② SERIAL NUMBER: 626ANB0001 V1.2 ③ DATE: MAY 15, 1985
④ SYS ⑤ RADIO OPTIONS: H288, H242, H291, H289, H269, H274, H238

TRUNKED SYSTEM INFORMATION

①	**1>**	– SYSTEM POSITION FOR A TRUNKED SYSTEM PROGRAMMED INTO THE UNIT
②	**SYSTEMS OPTIONS**	– OPTIONS IN EFFECT FOR A SPECIFIC SYSTEMS POSITION (Y = YES or N = NO)
③	**CTN**	– CONNECT TONE FREQUENCY IN HZ
④	**TOT**	– TIME OUT TIMER TIME IN SECONDS
⑤	**PI**	– PHONE INTERCONNECT
⑥	**PC**	– PRIVATE CALL
⑦	**CA**	– CALL ALERT
⑧	**DR**	– DYNAMIC REGROUPING
⑨	**TS**	– TRUNKING SUBFLEET SCAN
⑩	**EA**	– EMERGENCY ALARM
⑪	**EC**	– EMERGENCY CALL
⑫	**FS**	– FAILSOFT
⑬	**SYSID**	– SYSTEM ID NUMBER SYSTEM NAME FLEET NAME UNIT NAME
⑭	**SUBFL**	– LIST OF SUBFLEETS (FL MEANS FLEET CALL, ST MEANS STOP)
⑮	**CCFQY**	– CONTROL CHANNEL FREQUENCIES OF SYSTEM IN MHZ
⑯	**FSFQY**	– FAILSOFT CHANNEL FREQUENCY OF SYSTEM IN MHZ
⑰	**SCANM**	– LIST OF SUBFLEETS TO BE SCANNED (01-A MEANS SYSTEM 1, SUBFLEET A)
⑱	**PC/CA**	– LIST OF UNIT NAMES BY POSITION THAT A UNIT CAN PRIVATE CALL OR CALL ALERT

CONVENTIONAL SYSTEM INFORMATION

①	**2>**	– SYSTEM POSITION FOR A CONVENTIONAL SYSTEM PROGRAMMED INTO THE UNIT
②	**RCVR FREQ**	– RECEIVER CHANNEL FREQUENCY IN MHZ
③	**RX CODE**	– PL, DPL OR CARRIER SQUELCH CODE OF RECEIVER CHANNEL
④	**XMIT FREQ**	– TRANSMITTER CHANNEL FREQUENCY IN MHZ
⑤	**TX CODE**	– PL, DPL OR CARRIER SQUELCH CODE OF TRANSMITTER CHANNEL
⑥	**SYSTEMS OPTIONS**	– OPTIONS IN EFFECT FOR A SPECIFIC SYSTEMS POSITION (Y = YES or N = NO)
⑦	**TOT**	– TIME OUT TIMER SETTING IN SECONDS
⑧	**RO**	– RECEIVE ONLY
⑨	**DI**	– DPL INVERT ON TRANSMIT
⑩	**TA**	– TALKAROUND

TRUNKED EXAMPLE:

	③ CTN	④ TOT	⑤ PI	⑥ PC	⑦ CA	⑧ DR	⑨ TS	⑩ EA	⑪ EC	⑫ FS
② SYSTEM OPTIONS:	105	060	Y	Y	Y	Y	Y	Y	Y	N

SYS
TRUNKED
① 1> ⑬ SYSID: 0503400001 MOUNTAIN AREA ACE TRUCKING JOHN D.
⑭ SUBFL: A = 01 B = 02 C = 03 D = 04 E = 05 F = 06 G = 07 H = 08 I = 09 J = 10 K = 11 L = 12 M = 13 N = 14 O = 15 P = FL
⑮ CCFQY: 860.312500 859.312500 858.312500 857.312500
⑯ FSFQY: 860.312500
⑰ SCANM: 01-A, 01-B, 01-C, 01-D, 01-E
⑱ PC CA: STX UNIT #1 STX UNIT #2 STX UNIT #3 STX UNIT #4 STX UNIT #5 STX UNIT #6 STX UNIT #7 STX UNIT #8

CONVENTIONAL EXAMPLE:

	② RCVR FREQ	③ RX CODE	④ XMIT FREQ	⑤ TX CODE	⑥ SYSTEMS OPTIONS:	⑦ TOT	⑧ RO	⑨ DI	⑩ TA
① 2>	815.262500	CSQ	860.762500	CSQ		060	N	N	N

EXAMPLE OF RADIO INFORMATION SHEET

UNIT SERIAL NUMBER 626AKJ0056

MODEL: H25STE5170BN SERIAL NUMBER: 626AKJ0056 V1.2 DATE: Thu May 16, 1985
SYS RADIO OPTIONS: H238, H288, H289, H269, H242, H274, H291 P P C D T E E F
SYSTEM OPTIONS: CTN TOT I C A R S A C S
105 60 Y Y D Y Y Y Y Y
TRUNKED
1> SYSID: 122D100142 /FLORIDA ENGINEERS /TEST SYSTEMS /AREA # 1 /
SUBFL: A=01 B=02 C=03 D=04 E=05 F=06 G=07 H=07 I=09 J=10 K=11 L=12 M=13 N=14 O=15 P=FL
CCFQY: 860.762500 859.762500 858.762500 857.762500
FSFQY: 860.762500
SCANM: 01-A,01-B,01-C,01-D,01-E
PC/CA: ANNE LICA /JIM WILKINSON /ADOLFO CRESPO /MIKE BOYCE /BARRIE HOBBY /OZZIE RAMOS /DAVE HANSEN /RAFAEL MUNOZ

CONVENTIONAL

	RCVR FREQ	RX CODE	XMIT FREQ	TX CODE
2>	854.987500	023	809.987500	023
3>	854.987500	023	854.987500	023

SYSTEM OPTIONS: R D T
TOT O I A
30 N N N
30 N N Y

TRANSCEIVER PERFORMANCE TESTING and ALIGNMENT

GENERAL:
The radio has been prepared to meet published specifications through its manufacturing process with the use of laboratory quality test equipment of highest accuracy.

Field Service equipment that has been recommended approaches the accuracy of the manufacturing equipment with a few exceptions. (Accuracy of the equipment must be maintained with compliance to the equipment manufacturers recommended calibration schedule.)

In normal field operation, the radio microcomputer controls the RF channel selection, transmitter key-up, and receiver muting functions. However, when the unit is on the bench for performance testing or alignment, and is out of its normal operating environment, the radio microcomputer will not key the transmitter or unmute the receiver and this prevents the use of normal tuneup procedures. To solve this problem, a special test routine has been incorporated in the radio called TEST MODE which will be utilized throughout the following procedures.

PRECAUTIONS:

- The Transmitter Output Power measurement is to be taken at the radio antenna base using the 5880348B33 adapter. The Power value is to be taken using the Thru-line wattmeter S1350C terminated with a 50 ohm dummy load. (Caution, any length of coax cable used will reduce the power reading by the cable loss and VSWR).
- The Discriminator Quad coil adjustment is made after removal of the top front shield.
- The Squelch adjustment is accessible after removing the radio control top using the extender RTK-4080A. The adjustment is made through a shield hole from the back of the radio Transceiver Board.

SETUP:
To gain access to the Transceiver adjustments it is necessary to remove the radio lower housing.

Supply voltage can be connected from the battery eliminator (RTL-4199A) once the battery adapter (RTL-4206A) is fastened to the radio frame.

The equipment required for alignment procedures is connected as shown in the ALIGNMENT SETUP DIAGRAM.

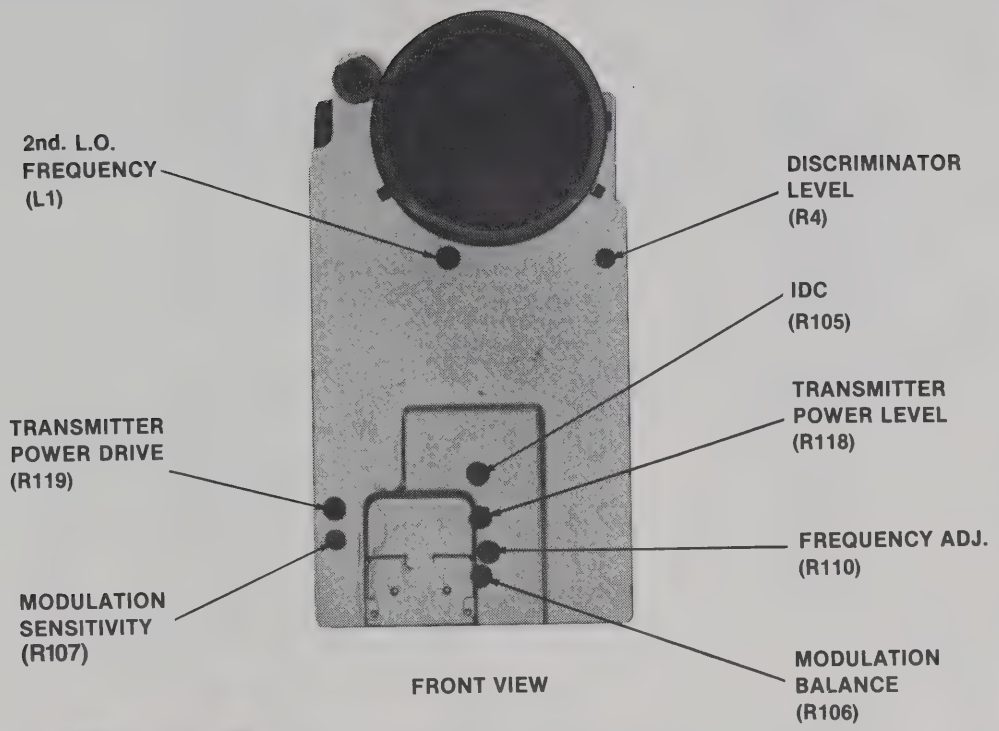
Initial equipment control settings should be as follows and will hold for all alignment procedures except as noted in the table.

Service Monitor	Test Box	Power Supply
Monitor Mode: Pwr Mon RF atten: −70 AM,CW,FM: FM Oscope Source: Mod Oscope Horiz: 10mSec/Div Oscope Vert: 2.5kHz/Div Oscope Trig: Auto Monitor Image: Hi Monitor BW: Nar Monitor Sqlch: mid CW Monitor Vol: ¼ CW	MT/MX: MX Spkr/load: Spkr PTT: OFF (cntr)	Voltage: 7.5vdc DC on/stdby: Stdby Volt Range: 10 Current: 2.5

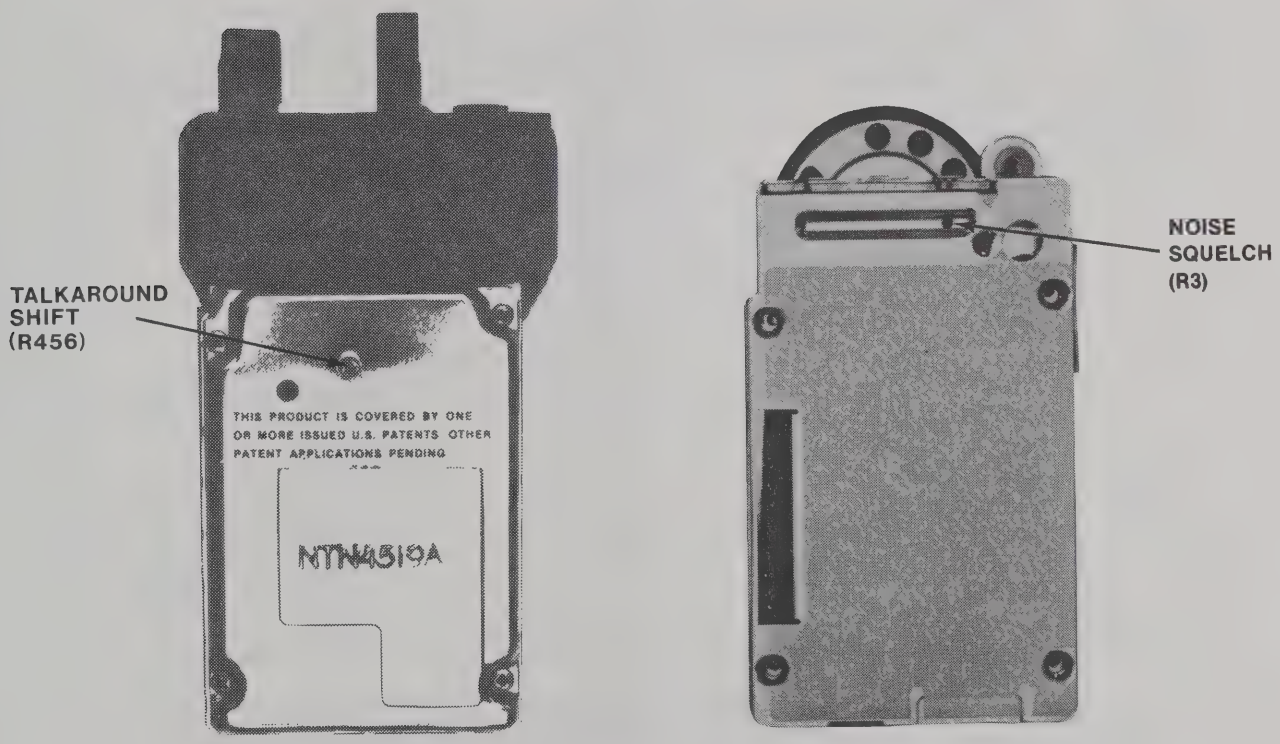
PROCEDURE:
Conditions of the equipment and radio are described in the following tables.

The radio is aligned for most cases while in the TEST MODE, see the description of TEST MODE for details on proper entry into this mode.

ALIGNMENT POINTS



FRONT VIEW



REAR VIEW

AEPF-16806-B

TEST MODE FUNCTION EXPLANATION

An STX radio has a built-in capability that allows bench testing of the Receiver and Transmitter under some specific conditions as well as a capability to do some controller diagnostics.

The TEST MODE is entered by using the following sequences:

1)- Turn radio volume control to ON.
2)- Press the TEST MODE pushbutton switch on cable RTK-4079A (approx 2 sec's then release). Unsquelched receive audio is heard indicating successful entry into TEST MODE.

Every model radio has a PTT switch and an orange push-button switch near the radio antenna. In the explanation of TEST MODE, the orange button will be referred to as the CONTROL KEY. Both the radio PTT switch and the CONTROL KEY are used to control the radio while it is in the TEST MODE.

The Table below shows the action required for the various TEST MODE conditions, the condition description, and the indication.

TEST MODE FUNCTION EXPLANATION			
TEST		**CONDITION, DESCRIPTION AND**	
NAME	**ACTION**	**INDICATION**	
Begin	Turn radio vol control to ON		
Self Test Digital	during above	indicates failure	indicates good
		1, 1kHz beep (U402, bad uP RAM)	no beep
		2, 1kHz beeps (U403, bad external RAM)	no beeps
		3, 1kHz beeps (U401, bad watchdog)	no beeps
		4, 1kHz beeps (U402, bad mask ROM)	no beeps
		5, 1kHz beeps (U404, bad UV ROM)	no beeps
		1, 1sec beep + continuous illegal mode tone (U405, bad EE PROM)	no beep/tone
Enter Test Mode	press button on cable (See Note 3)	Radio serial number (display models only) receive audio	
Carrier Freq Change	Quick-Key PTT, Quick-Key again Quick-Key again (see note 1)	display indication (see note 2)	audio indication
		510125US	(1 beep)
		699875US	(2 beeps)
		605125US	(3 beeps)
		(the "8" in freq's ,ie 851.0125 is not displayed)	
Tx	Long-Key fo continuous Transmit	use any one of above freqs (the Tx freq = the displayed Rx freq - 45MHz)	
Rx	No-Key for continuous Receive	use any one of above freqs	
Squelch & Modulation modes	Press the CONTROL KEY on the Radio Control Top	last two symbols displayed	radio conditions
		US = Rx	UnSq,Tx mic dev
		LS = Rx	UnSq,Tx mic + connect tone
		HS = Rx	Sq,Tx 1800Hz,no mic
		CL = Rx	Sq,Tx 75Hz,no mic
		dO = Rx	Sq, unless carrier, Tx DTMF Tone, Pair 0. Press desired DTMF key to change DTMF pair.

Notes :

1- If synth lock problems exist, low freq beeps will be heard and "lck" graphic symbol will flicker.
2- Radios with no display will indicate the active frequency with audible beeps. Radios with display will indicate visually and audibly. In the "Transmit" mode, the radio will display 06.0125, 24.9875 and 15.5125 for Test Frequency One through Three, respectively.
3- "QUICK KEY" is accomplished by tapping the PTT switch and letting go.

TEST EQUIPMENT SET-UP TABLE

Referenced Service Aids

Reference No.	Description	Number
1	Antenna RF Connector	58-80348B33
2	Radio to Test Box Interface Cable	RTK-4079A
3	Battery Block	RTL-4199A
4	Frame to Battery Block Adapter	RTL-4206A
5	Control Top Extender Cable	RTK-4080A
6	Controller Board Extender	RTL-4207A

Non-Referenced Service Aids

	Description	Number
	Side Connector Transmit Power Cable	RTK-4087A
	50 Ohm Analysis Test Cable	RTL-4208A
	Radio Test Box	RTX-4005A

Test Equipment

	Description	Number
	Service Monitor	R2210A
	Power Supply	S1347D
	Watt Meter	S1350C
	—Plug-in Element (5 Watt Max.)	ST1232B
	—Dummy Load	T1013A
	RF Millivoltmeter	S1339A
	Dual-Trace Oscilloscope	R1029A with 220 option

RECEIVER PERFORMANCE: (power supply at 7.5 vdc)

Performance Name	Serv Monitor to	Radio to	Test Box to	Comments
Reference frequency	see Transmitter performance test for this and procede with other receiver tests below			
Rated Audio	Gen,1.0mvRF freq 860.5125, 1kHz tone @ 3kHz dev,DVM,ACV.	TEST MODE, 60.5125US, (3 beeps).	PTT to OFF (center) meter selector to Audio PA	set volume control to 1.95-2.0 vrms
Distortion	as above, except to distortion	as above	as above	Distortion < 8.0%
Sensitivity (SINAD)	as above, except SINAD, lower the RF level for 12dB SINAD.	as above	PTT to OFF (center)	RF input to be < 0.35uV
Noise Squelch Threshold (only radios with conv system need to be tested)	RF Level set to 1 mV RF	as above	PTT to OFF, meter selector to Audio PA, spkr./load to spkr.	Radio vol to 1.95-2.0 vrms
	as above, except.. (*) change freq to the Conventional system Raise RF level from zero until radio unsquelches	out of TEST MODE, select a Conventional system	as above	unsquelch to occur at >0.25uV preferred SINAD=6dB

*Frequency associated with a Conventional system with carrier squelch can be found on the Customer Information Sheet shipped with the radio.

TRANSMITTER PERFORMANCE: (power supply at 7.5Vdc)

Performance Name	Serv Monitor to	Radio to	Test Box to	Comments
Reference frequency	Pwr Mon, Freq 815.5125, Freq Error, input at RF In/Out	TEST MODE, 60.5125US, (3 beeps), output at antenna	PTT to continuous (during the performance check)	Freq. Error to be <450Hz
Power RF	Connect radio to Thru-line wattmeter with 50 ohm load.	(#) TEST MODE 69.9875US, output at antenna	PTT to cont during the perfor .heck)	Power to be ≥ pub spec (*) (<>)
Power RF (CVC pwr)	as above, except couple radio to meter using RTK-4087 cable.	as above	as above	Power to be ≥ .83w for 1 watt models; ≥ 2.49w for 3 watt models
Voice Modulation external	Pwr Mon, dev, 815.5125, atten to -70. input to RF In/Out DVM, AC. set 1kHz Mod out level for 0.025 vrms at test box	TEST MODE, 60.5125LS output at antenna	as above, meter selector to mic	dev to be ≥ 5.0kHz ≥ 3.8kHz
Modulation Sensitivity	as above, except lower Mod out level for 3kHz deviation	TEST MODE, 60.5125US, output at antenna	as above	ACV to be .005-.013 vrms
Voice Modulation internal	Power Monitor, Deviation, 815.5125, Attenuation to -70, input input to RF In/Out.	TEST MODE, 60.5125LS, Output at antenna	Remove modulation input	Key PTT switch on radio, Speak loudly "four" into the radio microphone, Measure deviation to be ≥ 3.8kHz, ≤ 5.0kHz.
High speed data modulation	as above	60.5125HS	PTT to continuous (during the performance check)	Deviation to be ≥ 2.4kHz, ≤ 3.6kHz.
DTMF modulation	as above	60.5125dO	PTT to continuous	Deviation to be ≥ 3.8kHz, ≤ 5.0kHz.
PL/DPL modulation (conventional radios with coded squelch only)	Change frequency to conventional transmit frequency	Conventional system coded squelch	PTT to continuous	Deviation to be ≥ 500Hz, ≤ 1000Hz.
Talkaround modulation (conventional radios with talkaround systems only)	Change frequency to conv. talkaround frequency, Pwr Mon, dev, atten to -70. input to RF In/Out DVM, AC. Set 1kHz Mod out level for 0.025vrms at test box	Conventional talkaround system	PTT to continuous meter selector to mic	Deviation to be ≥ 3.8kHz, ≤ 5.0kHz

* Transmitter power value to be taken before radio heats up.

\# Radios having Conventional Systems with Talk-Around are capable of transmitting on their receive frequencies. For those radios, the performance for Tx Power should be judged with the radio in the highest Conventional system Talk-Around freq.

<> Appropriate transmitter rated output power can be determined by interpreting the radio model number. H25xxx5170CN is 1 watt, H35xxx5170CN is 3 watt.

RECEIVER ALIGNMENT: (power supply at 7.5Vdc)

Alignment Name	Serv Monitor to	Radio to	Test Box to	Adjust for
Reference frequency	see Transmitter alignment, must be on freq to procede with other receiver alignments below.			
2nd L.O. frequency	Sens Mon, freq 44.5075, Freq Error, input @ antenna, attenuator to zero, couple signal near tuning tool.#	TEST MODE, 60.5125US (3 beeps)	PTT to OFF (center)	L001 for zero FREQ ERROR
Discriminator Level	Gen, 1.0mvRF, freq 860.5125, 1kHz tone @ 3kHz dev, DVM, ACV.	as above (Volume Control to min).	PTT to OFF (center) MTR SEL to DISC.	R004 for .19 to .21 Vrms
Noise Squelch Threshold (only radios with conv system & carrier squelch)	as above	as above	PTT to OFF, MTR SEL to Audio PA, spkr./load to spkr.	Radio vol to 1.95-2.0Vrms
	as above except (*) change freq to the Conventional system sel SINAD. Lower RF level for 6dB SINAD	out of TEST MODE, select a Conventional system	as above	R003 for unsquelch @ 6dB SINAD

* Frequency associated with a Conventional system with carrier squelch can be found on the Customer Information Sheet shipped with the radio.

\# Connect center conductor of monitor input to tuning tool blade to "sniff" I.F. frequency.

TRANSMITTER ALIGNMENT: (power supply at 7.5Vdc)

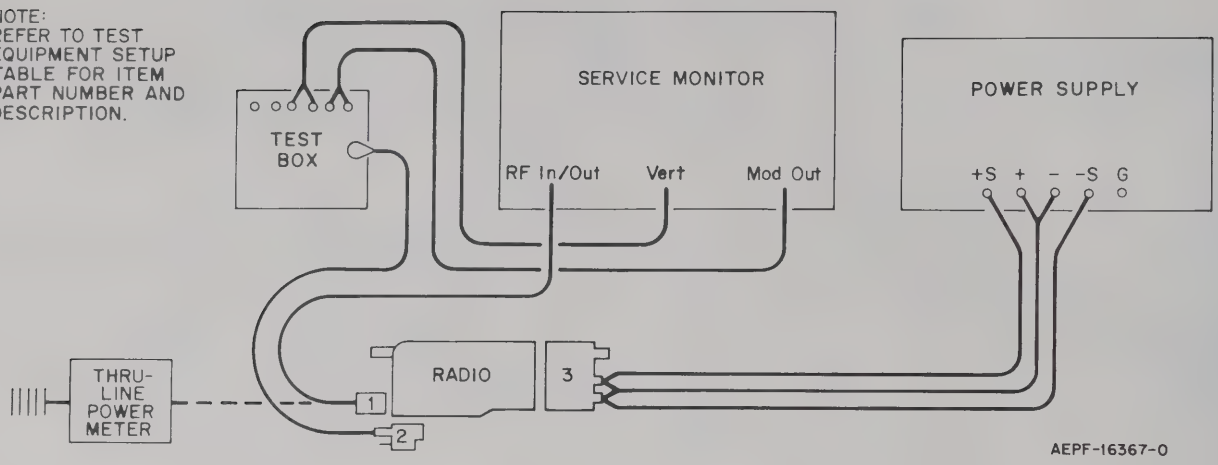
Alignment Name	Serv Monitor to	Radio to	Test Box to	Adjust for
Power RF Drive	Connect radio to Thru-line wattmeter with 50 ohm load.	(#) TEST MODE 69.9875US, output @ antenna	PTT to cont (during the alignment)	R119 for 100mw above rated power (<>)
Power RF Leveling (only after Drive alignment)	as above	as above	as above	R118 for rated power (<>)
Reference frequency	Pwr Mon, freq 815.5125, Freq Error, input @ RF In/Out	TEST MODE, 60.5125US, (3 beeps), output @ antenna	PTT to cont (during alignment)	R110 for zero FREQ ERROR
Modulator Balance	Pwr Mon, dev, 815.5125, atten to -70. input to RF In/Out	TEST MODE 60.5125CL, output @ antenna	as above	R106 to compensate for any initial drop in the square wave displayed on the monitor*
Modulator Sensitivity (LS data)	as above	TEST MODE, 60.5125LS, output @ antenna	as above (no mic input)	R107 for 900Hz deviation
Modulation voice Limiting	as above, except DVM, AC	TEST MODE, 60.5125LS, output @ antenna	meter selector to mic. Measure level at AC/DC Mtr. point	set Serv Mon Mod out level for 25mvrms
	as above, except dev.	as above	PTT to cont (during the alignment)	R105 for 4.5kHz deviation
Talkaround modulation (conventional radios with talkaround systems only)	Change frequency to conv. talkaround frequency nearest 860.5125MHz (midband), Pwr Mon, dev, atten to -70, input to RF In/Out DVM, AC.	Conventional talkaround system of frequency nearest 860.5125MHz (midband)	meter selector to mic. Measure level at AC/DC Mtr. point	set Serv Mon Mod out for 25mvrms
	as above, except dev.	as above	PTT to cont. (during the alignment)	R456 for 4.5kHz deviation

\# Radios having Conventional Systems with Talk-Around are capable of transmitting on their receive frequencies. For those radios, the alignment for Tx Power drive and Tx Power leveling should be done with the radio in the highest Conventional System Talk-Around freq.

<> Appropriate transmitter rated output power can be determined by interpreting the radio model number. H25xxx5170CN is 1 watt, H35xxx5170CN is 3 watt.

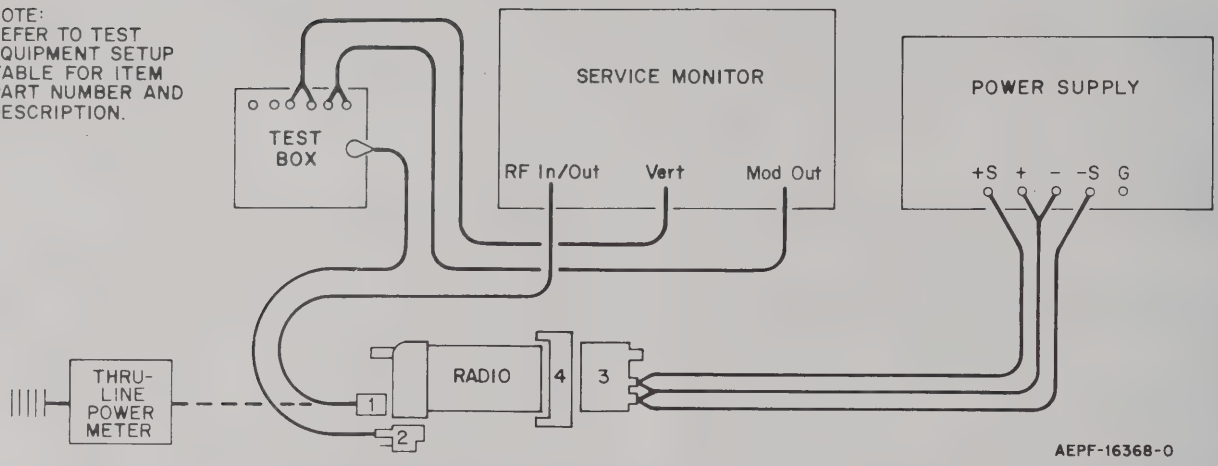
* Compensated. Under compensated. Over compensated.

NOTE:
REFER TO TEST EQUIPMENT SETUP TABLE FOR ITEM PART NUMBER AND DESCRIPTION.



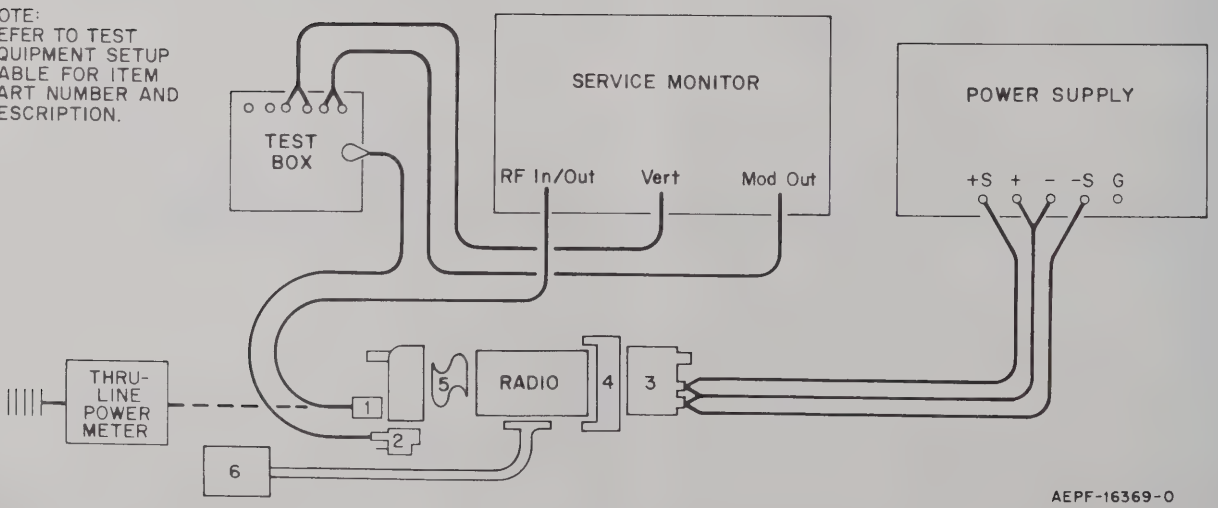
STX TEST SETUP

NOTE:
REFER TO TEST EQUIPMENT SETUP TABLE FOR ITEM PART NUMBER AND DESCRIPTION.



STX ALIGNMENT SETUP

NOTE:
REFER TO TEST EQUIPMENT SETUP TABLE FOR ITEM PART NUMBER AND DESCRIPTION.



STX ANALYSIS SETUP

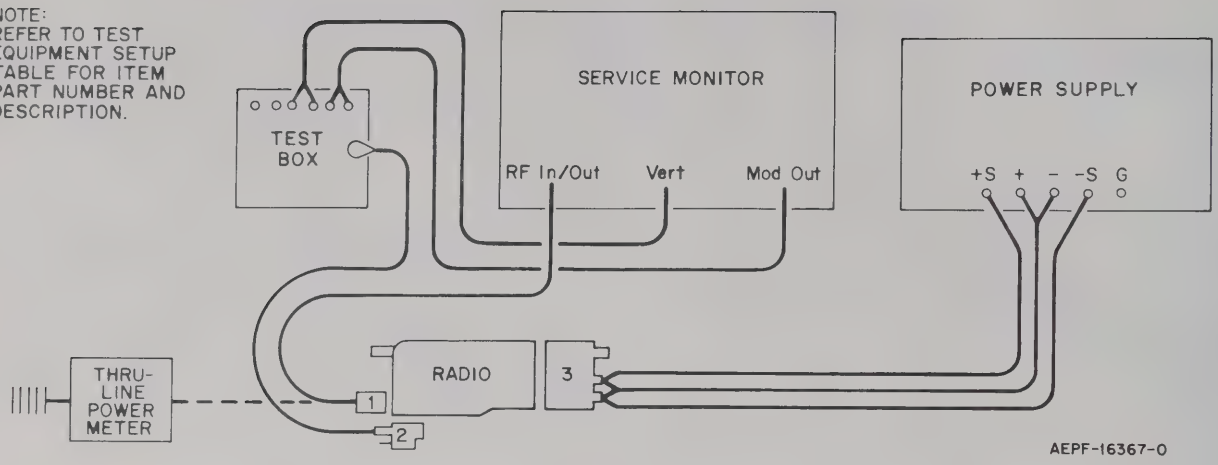
TRANSCEIVER PARTS LIST
NUF6040C 1-Watt Transceiver Board
NUF6050C 3-Watt Transceiver Board

TPLF-3442-

REFERENCE ITEM	MOTOROLA PART NO.	DESCRIPTION
		CAPACITORS: pF ± 5%; 35V unless otherwise stated
C3	2382397D15	10uF ± 20%; 20V
C5	2382397D15	10uF ± 20%; 20V
C6	2383397D26	0.47uF ± 10%
C7	2382397D08	0.15uF + 40-20%
C8	2382397D15	10uF ± 20%; 20V
C10	2184008H02	.0033uF ± 10%; 50V
C11	2382397D16	22uF ± 20%; 15V
C12	2382397D15	10uF ± 20%; 20V
C13	2382397D21	47uF ± 20%; 6V
C14	2382397D16	22uF ± 20%; 15V
C15	2382397D21	47uF ± 20%; 6V
C16	2382397D21	47uF ± 20%; 6V
C17	2382397D05	4.7uF + 40-20%; 4V
C101	2382397D15	10uF ± 20%; 20V
C103, 104	2382397D09	6.8uF ± 20%; 10V
C109 thru 112	2382397D15	10uF ± 20%; 20V
C114	2382397D15	10uF ± 20%; 20V
C116 thru 118	2382397D07	1uF + 40 − 20%; 20V
C120	2382397D15	10uF ± 20%; 20V
C121	2382397D16	22uF ± 20%; 15V
C124	2184008H02	.0033uF ± 10%; 50V
C208	2160520C01	100
C209	2160520P07	1800
C210	2160520C01	100pF ± 5%; 35V
C211	2160521A28	.018uF; 25V
C212	2160520B11	27
C214	2160520A09	2.2 ± 0.25pF; 50V
C216	2105632D43	1.8 ± 0.25pF; 50V
C301	2160520B11	27
C302	2160521H39	0.15uF
C305 thru 307	2160521A28	.018uF; 25V
C308	2160520B11	27
C309, 310	2160520B01	10
C311	2160521A28	.018uF; 25V
C315	2160521A28	.018uF; 25V
C316, 317	2160520B11	27
C318	2160521C19	.0033uF
C319	2160520B11	27
C322	2160520A28	.018uF; 10V
C323	2160520B11	27
C325	2160521A28	.018uF; 25V
C326	2160521N37	0.1uF ± 10%; 10V
C328 thru 333	2160520B11	27
C335	2160520B11	27
C336	2160521A28	.018uF; 25V
C337	2160520B11	27
C339	2160521A28	.018uF; 25V
C340	2160520B11	27
C341	2160521A28	.018uF
C342 thru 345	2160520B11	27; 25V
C346	2160521F33	.047 ± 20%; 10V
C348, 349	2160521A28	.018uF; 25V
		DIODES:
CR1	4805893D01	Silicon
CR2	4883654H01	Silicon
CR201	4805129M41	Silicon
CR206	4805129M40	Silicon
CR303	4805129M12	Twin Silicon
CR305, 306	4805129M41	Silicon
		JACK:
J3	0905709N01	Connector, 28-pin
J4	0905006P01	Connector, Coax
		COILS:
L1	2405127L02	Variable, 800-1140nH
L2	2405716G02	Variable, 446-464kHz
L102	2482723H04	290nH
L103	2482723H22	150nH
L104	2482723H04	290nH
L105	2482723H22	150nH
L106	2482723H04	290nH
L107	2482723H22	150nH
LS501	5005471N01	**TRANSDUCER, 8Ω**
MK501	5005227J02	**MICROPHONE**
P2	0905212P01	**PLUG,** Connector, 5-pin

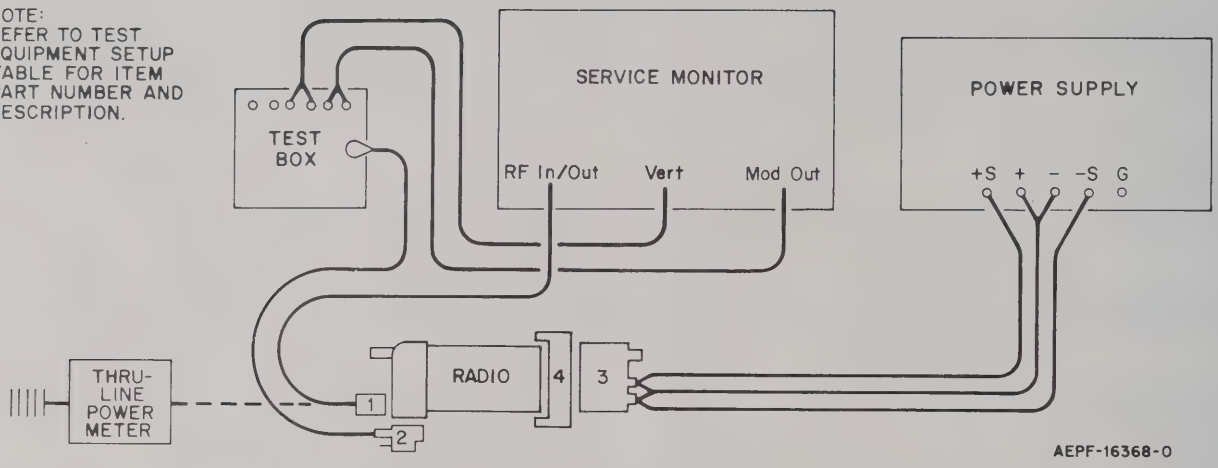
NONREFERENCED ITEMS		
	1405160A02	Insulators for Y1 and FL1 (2)
	0705196A04	Boots for Y1 and FL1 (2)
	0300136783	PA Screws (2)
	0300136782	VCO Screws (2)
	0405683D04	VCO Lockwashers
	2605493Q01	Mumetal Shield
	2605552Q01	VCO shim
	0905287C07	Module Sockets (21) High Power
	0905287C07	Module Sockets (22)
	1105668K16	Side Pads for Modules (6)
	1105668K17	Side Pad for Module (1)
	1105668K31	Side Pad for Module (1)
	1405305G06	Insulators (2), for X2 Multiplier
	1405305G07	Insulator (1), for VCO Module
	3782378B14	Boot for C110
	2605391Q01	Coil Shield (L1)
	7505506D02	Bottom Pad (1) Injection Module
	7505506D07	Bottom Pads (2) Oscillator Module
	7505506D09	Bottom Pads (2) for 2-Pole Filter
	7505506D11	Bottom Pads (4) RF Pre-Amp, IDC Modules, Nucleus
	7505506D21	Bottom Pad (1) for ALR Module
	7505506D26	Bottom Pad (1) for Mixer Module
	7505506D27	Bottom Pad (1) Synthesizer Module
	7505506D28	Bottom Pads (2) Frequency Multiplier, Transmit buffer Modules
	4205474P02	B + Clip

NOTE:
REFER TO TEST EQUIPMENT SETUP TABLE FOR ITEM PART NUMBER AND DESCRIPTION.



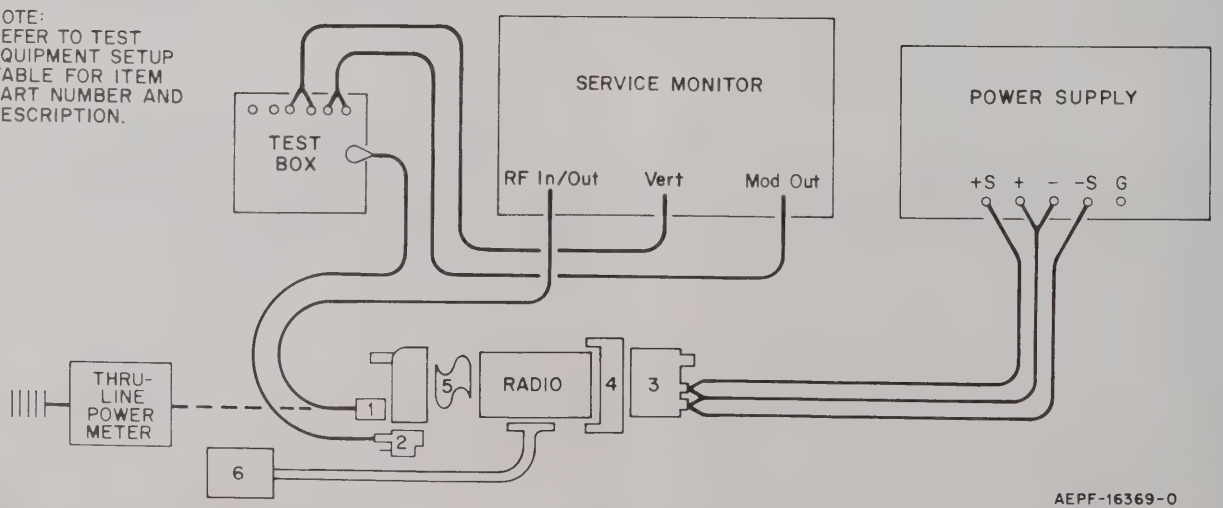
STX TEST SETUP

NOTE:
REFER TO TEST EQUIPMENT SETUP TABLE FOR ITEM PART NUMBER AND DESCRIPTION.



STX ALIGNMENT SETUP

NOTE:
REFER TO TEST EQUIPMENT SETUP TABLE FOR ITEM PART NUMBER AND DESCRIPTION.



STX ANALYSIS SETUP

TRANSCEIVER PARTS LIST
NUF6040C 1-Watt Transceiver Board
NUF6050C 3-Watt Transceiver Board TPLF-3442-O

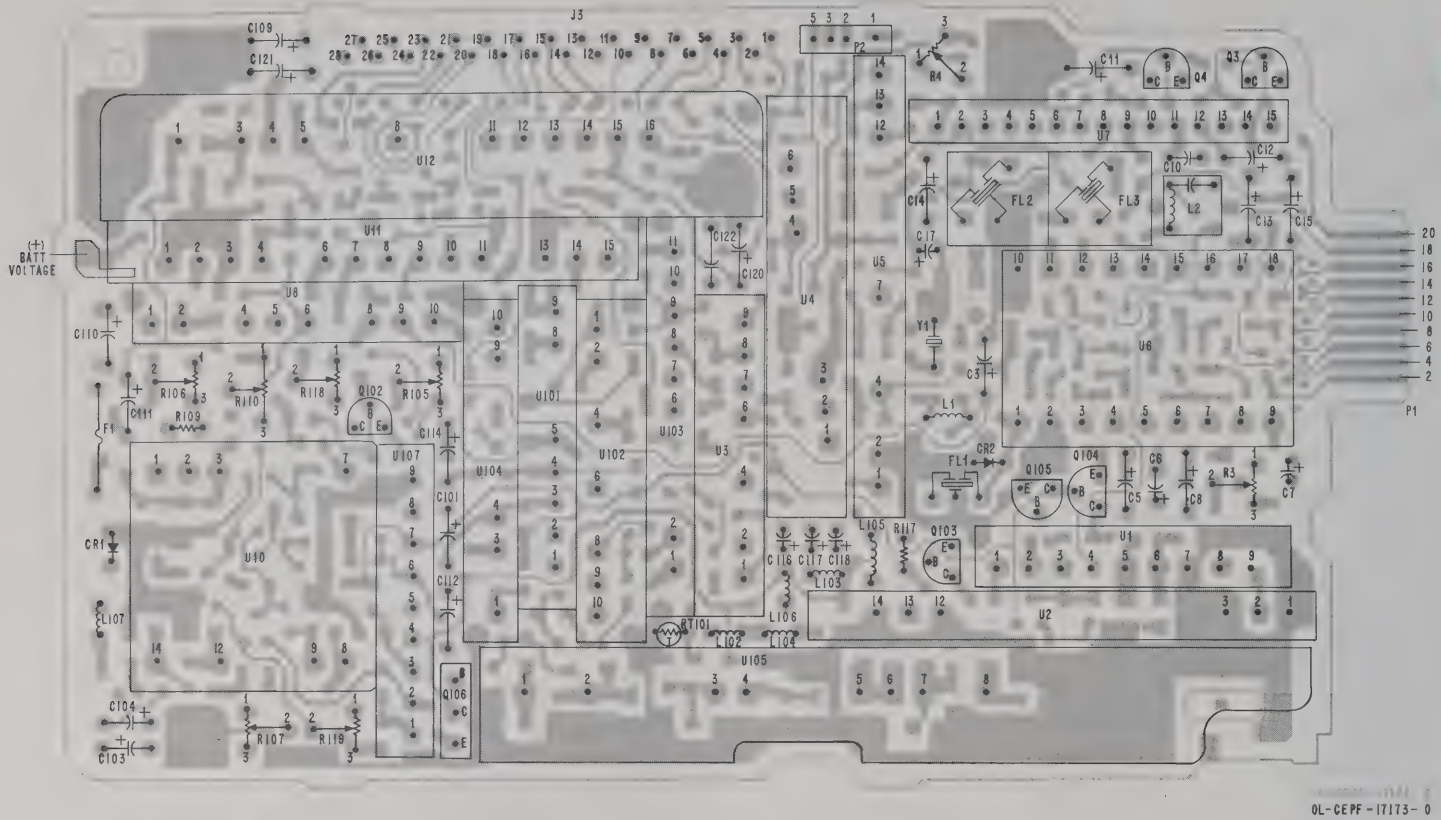
REFERENCE ITEM	MOTOROLA PART NO.	DESCRIPTION
		CAPACITORS: pF ± 5%; 35V unless otherwise stated
C3	2382397D15	10uF ± 20%; 20V
C5	2382397D15	10uF ± 20%; 20V
C6	2383397D26	0.47uF ± 10%
C7	2382397D08	0.15uF + 40-20%
C8	2382397D15	10uF ± 20%; 20V
C10	2184008H02	.0033uF ± 10%; 50V
C11	2382397D16	22uF ± 20%; 15V
C12	2382397D15	10uF ± 20%; 20V
C13	2382397D21	47uF ± 20%; 6V
C14	2382397D16	22uF ± 20%; 15V
C15	2382397D21	47uF ± 20%; 6V
C16	2382397D21	47uF ± 20%; 6V
C17	2382397D05	4.7uF + 40-20%; 4V
C101	2382397D15	10uF ± 20%; 20V
C103, 104	2382397D09	6.8uF ± 20%; 10V
C109 thru 112	2382397D15	10uF ± 20%; 20V
C114	2382397D15	10uF ± 20%; 20V
C116 thru 118	2382397D07	1uF + 40 – 20%; 20V
C120	2382397D15	10uF ± 20%; 20V
C121	2382397D16	22uF ± 20%; 15V
C124	2184008H02	.0033uF ± 10%; 50V
C208	2160520C01	100
C209	2160520P07	1800
C210	2160520C01	100pF ± 5%; 35V
C211	2160521A28	.018uF; 25V
C212	2160520B11	27
C214	2160520A09	2.2 ± 0.25pF; 50V
C216	2105632D43	1.8 ± 0.25pF; 50V
C301	2160520B11	27
C302	2160521H39	0.15uF
C305 thru 307	2160521A28	.018uF; 25V
C308	2160520B11	27
C309, 310	2160520B01	10
C311	2160521A28	.018uF; 25V
C315	2160521A28	.018uF; 25V
C316, 317	2160520B11	27
C318	2160521C19	.0033uF
C319	2160520B11	27
C322	2160520A28	.018uF; 10V
C323	2160520B11	27
C325	2160521A28	.018uF; 25V
C326	2160521N37	0.1uF ± 10%; 10V
C328 thru 333	2160520B11	27
C335	2160520B11	27
C336	2160521A28	.018uF; 25V
C337	2160520B11	27
C339	2160521A28	.018uF; 25V
C340	2160520B11	27
C341	2160521A28	.018uF
C342 thru 345	2160520B11	27; 25V
C346	2160521F33	.047 ± 20%; 10V
C348, 349	2160521A28	.018uF; 25V
		DIODES:
CR1	4805893D01	Silicon
CR2	4883654H01	Silicon
CR201	4805129M41	Silicon
CR206	4805129M40	Silicon
CR303	4805129M12	Twin Silicon
CR305, 306	4805129M41	Silicon
		JACK:
J3	0905709N01	Connector, 28-pin
J4	0905006P01	Connector, Coax
		COILS:
L1	2405127L02	Variable, 800-1140nH
L2	2405716G02	Variable, 446-464kHz
L102	2482723H04	290nH
L103	2482723H22	150nH
L104	2482723H04	290nH
L105	2482723H22	150nH
L106	2482723H04	290nH
L107	2482723H22	150nH
LS501	5005471N01	**TRANSDUCER, 8Ω**
MK501	5005227J02	**MICROPHONE**
P2	0905212P01	**PLUG,** Connector, 5-pin

		TRANSISTORS:
Q3	4805474G39	NPN
Q4	4805474G28	PNP
Q102	4805474G27	PNP
Q103	4805474G28	PNP
Q104	4800869680	NPN
Q105	4800869528	NPN
Q106	0105950M44	PNP
Q201	4805128M67	PNP
Q202	4805128M68	NPN
Q203	4805128M67	PNP
Q204	4805128M67	PNP
Q205	4811056B09	NPN
Q206	4805128M68	NPN
Q301, 302	4805128M68	NPN
Q303, 304	4805128M67	PNP
		RESISTORS: Ω ± 5%; ⅛W unless stated stated
R3	1805500L08	22k ± 20% Potentiometer
R4	1805500L10	47k ± 20% Potentiometer
R105	1805500L05	4.7k ± 20% Potentiometer
R106, 107	1805500L08	22k ± 20% Potentiometer
R109	0683175C04	10.5k ± 1%
R110	1884921N05	10k ± 10% Potentiometer
R117	1705530E26	0.2 ± 3%
R118	1805500L16	330 ± 20% Potentiometer
R119	1805500L02	470 ± 20% Potentiometer
R202	0660076A47	820
R204	0660076A83	27k
R205	0660076A81	22k
R206	0660076A77	15k
R208	0660076A73	10k
R210	0660076A73	10k
R215	0660076A79	18k
R216	0660076A49	1k
R217, 218	0660076B01	100k
R219, 220	0660076A29	150
R222	0660076U08	2.0
R223	0660076A73	10k
R224	0660079U08	2.0
R225	0660076B17	470k
R228	0660076B01	100k
R230	0660076B05	150k
R301	0660076B11	270k
R302	0660076A31	180
R303	0660076A57	2.2k
R307	0660076A92	62k
C308	0660076A01	10
R312	0660076A01	10
R313	0660076A17	47
R315	0660076A81	22k
R319	0660076A93	68k
R320	0660076A85	33k
R321	0660076A57	2.2k
R322	0660076A01	10
R323	0660076A51	1.2k
R324	0660076A39	390
R325	0660076A35	270
R326	0660076A25	100
R327	0660076A83	27k
R328	0660076A73	10k
R331	0660076A09	22
R332	0660076A01	10
R333	0660076B25	1M
R334	0660076A29	150
R340	0660076A61	3.3k
R342	0660076A01	10
R343	0660076A29	150
R344 thru 346	0660076A67	5.6k
R347	0660076A47	820
R348	0660076A61	3.3k
R349	0660076A25	100
R351	0660076A01	10
R352	0660076A01	10
R361	0660076L11	2.7
R363	0660076A63	3.9k
R364	0660076A73	10k
R365	0660076A53	1.5k
R367	0660076A31	180
R601	1805799P01	50k ± 20% Potentiometer
R605	0660075A43	560

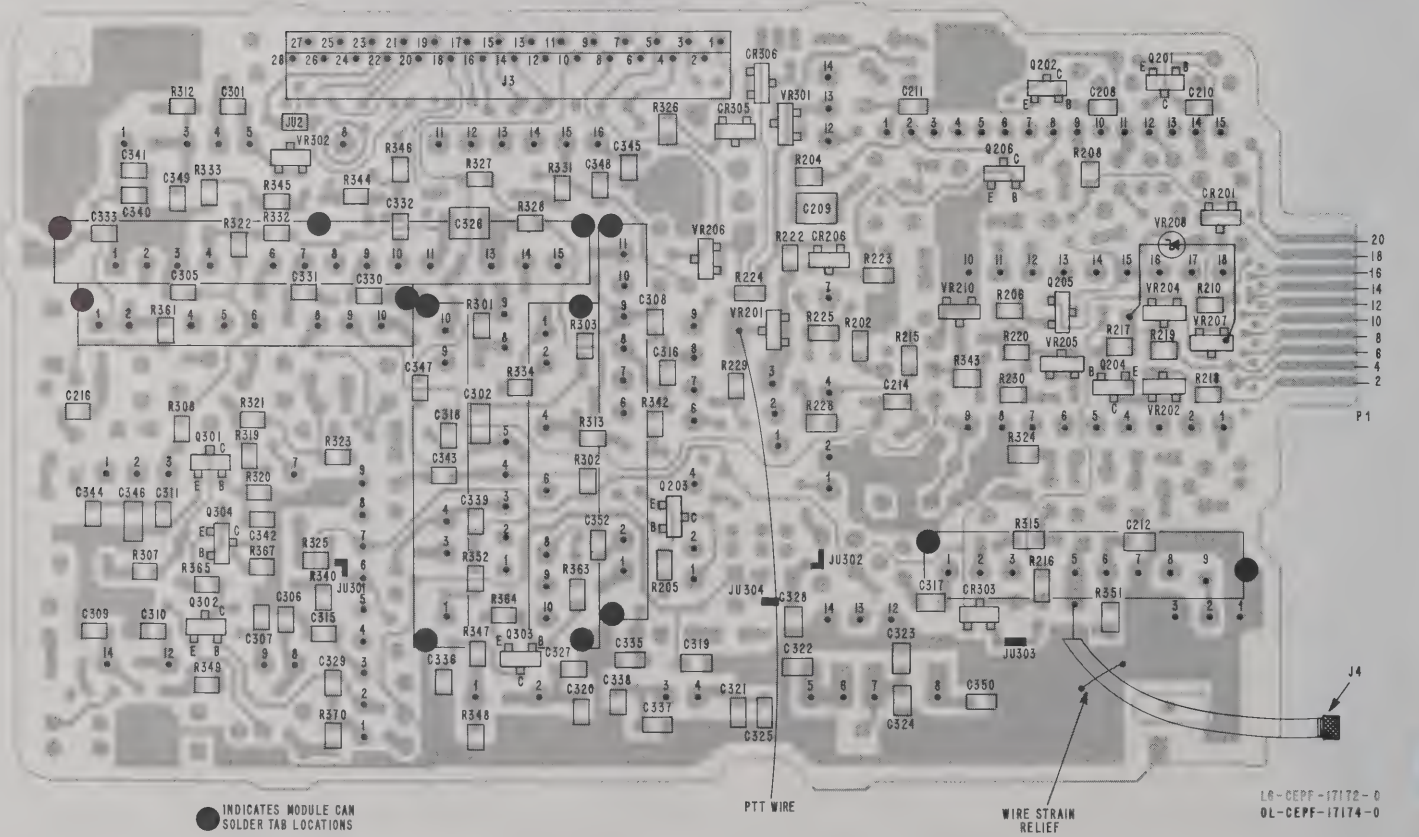
R613	0660075A49	1k
		THERMISTOR:
RT101	0605796B07	50k ± 10%
		MODULES:
U1	5105706L78	Antenna Switch
U2	5105706L74	Filter
U3	5105706L77	RF Pre-Amp.
U4	5105706L75	Filter
U5	5105706L92	Mixer
U6	5105337F38	I-F/Discriminator
U7	5105337F88	Audio Logic/Regulator
U8	5105706L87	Voltage Regulator
U10	5105706L84	Oscillator
U11	5105706L80	Synthesizer
U12	5105706L79	VCO
U101	5105706L91	"IDC"
U102	5105706L76	Frequency Multiplier
U103	5105706L82	Switch
U104	5105706L81	Transmit Buffer
U105	5105706L85	Power Amplifier, 3-Watt Models
	or 5105706L86	Power Amplifier, 1-Watt Models
U107	5105706L83	Automatic Level Control
		ZENER DIODES:
VR201	4805129M38	5.6V
VR202	4805129M38	5.6V
VR204	4805129M42	5.6V
VR205	4805129M38	5.6V
VR206	4805129M38	5.6V
VR207	4805129M42	5.6V
VR208	4883461E33	18V
VR210	4805129M42	5.6V
VR301	4880140L23	18V
VR302	4805129M38	5.6V
Y1	4805489G41	**CRYSTAL**
		FUSE:
F1	6505214E07	3-Amp
		FILTER:
FL1	4805245J15	44.9925MHz Crystal
FL2	4805368G03	455kHz Ceramic
FL3	4805368G10	455kHz Ceramic

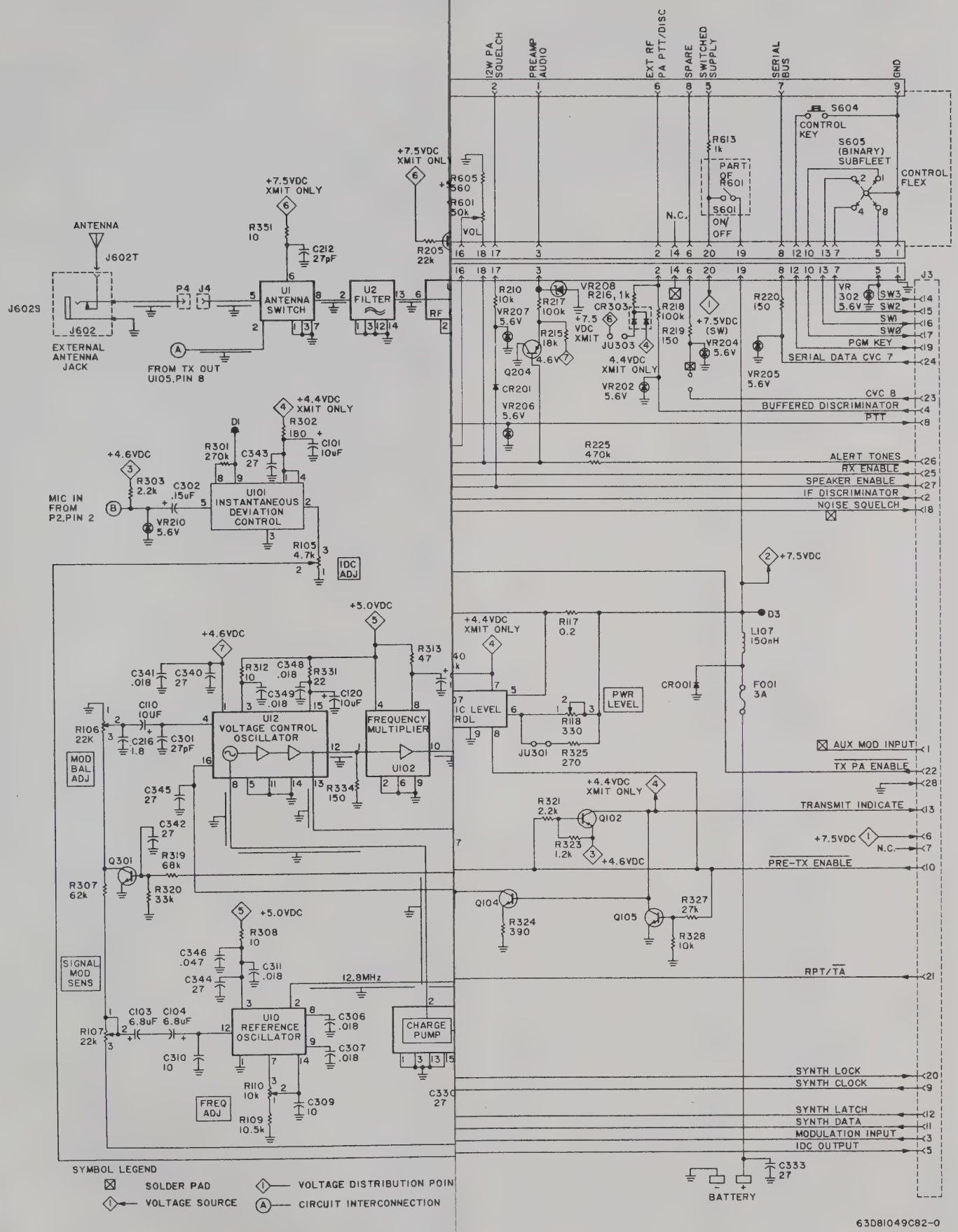
NONREFERENCED ITEMS		
	1405160A02	Insulators for Y1 and FL1 (2)
	0705196A04	Boots for Y1 and FL1 (2)
	0300136783	PA Screws (2)
	0300136782	VCO Screws (2)
	0405683D04	VCO Lockwashers
	2605493Q01	Mumetal Shield
	2605552Q01	VCO shim
	0905287C07	Module Sockets (21) High Power
	0905287C07	Module Sockets (22)
	1105668K16	Side Pads for Modules (6)
	1105668K17	Side Pad for Module (1)
	1105668K31	Side Pad for Module (1)
	1405305G06	Insulators (2), for X2 Multiplier
	1405305G07	Insulator (1), for VCO Module
	3782378B14	Boot for C110
	2605391Q01	Coil Shield (L1)
	7505506D02	Bottom Pad (1) Injection Module
	7505506D07	Bottom Pads (2) Oscillator Module
	7505506D09	Bottom Pads (2) for 2-Pole Filter
	7505506D11	Bottom Pads (4) RF Pre-Amp, IDC Modules, Nucleus
	7505506D21	Bottom Pad (1) for ALR Module
	7505506D26	Bottom Pad (1) for Mixer Module
	7505506D27	Bottom Pad (1) Synthesizer Module
	7505506D28	Bottom Pads (2) Frequency Multiplier, Transmit buffer Modules
	4205474P02	B + Clip

NUF6040C AND NUF6050C
Transceiver PCB, Layer 6, With Leaded Component Overlay.
Viewed From Side 2



NUF6040C AND NUF6050C
Transceiver PCB, Layer 6, With Leadless Component Overlay.
Viewed From Side 2

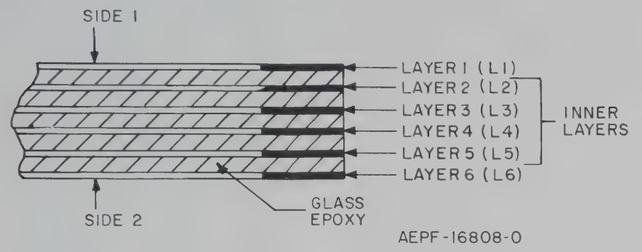




63D81049C82-0

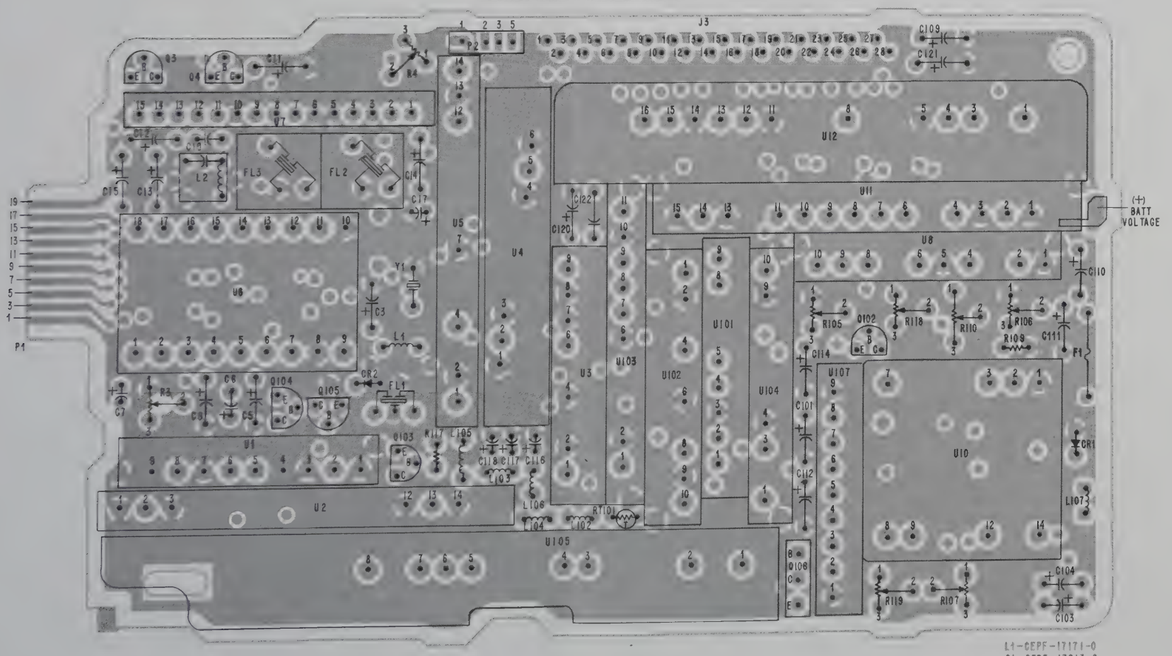
NUF6040C AND NUF6050C TRANSCEIVER SCHEMATIC DIAGRAM 15

6-LAYER CIRCUIT BOARD COPPER DETAIL VIEWING COPPER STEPS AT EDGE OF BOARD IN PROPER LAYER SEQUENCE.



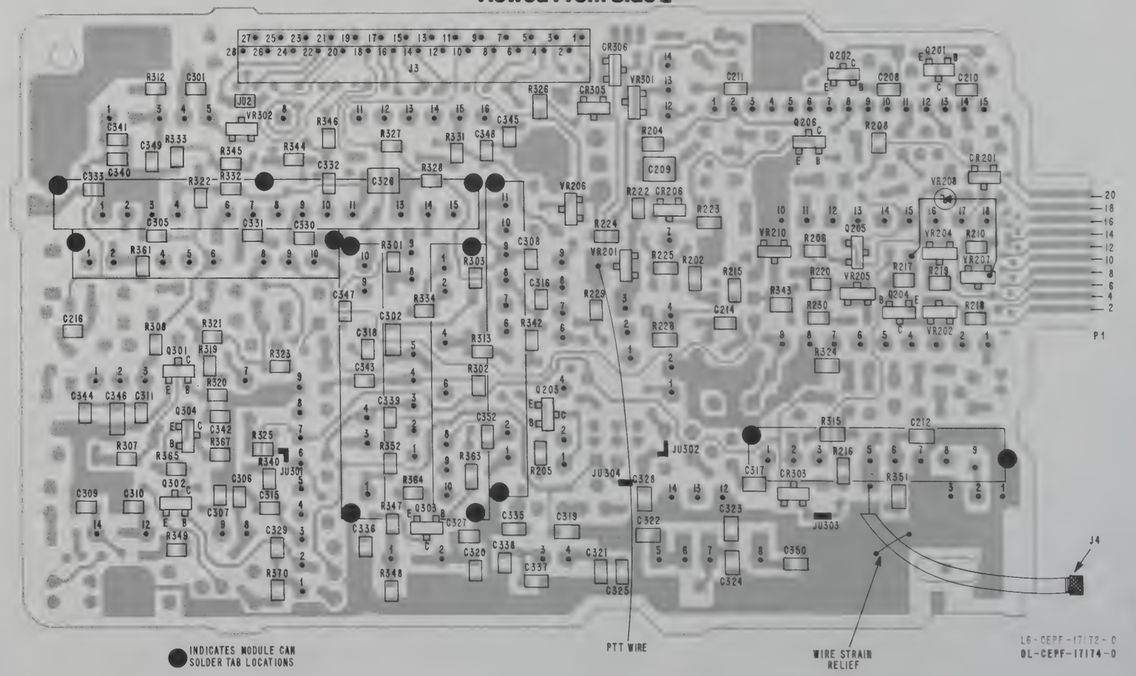
AEPF-16808-0

NUF6040C AND NUF6050C
Transceiver PCB, Layer 1, With Leaded Component Overlay.
Viewed From Side 1

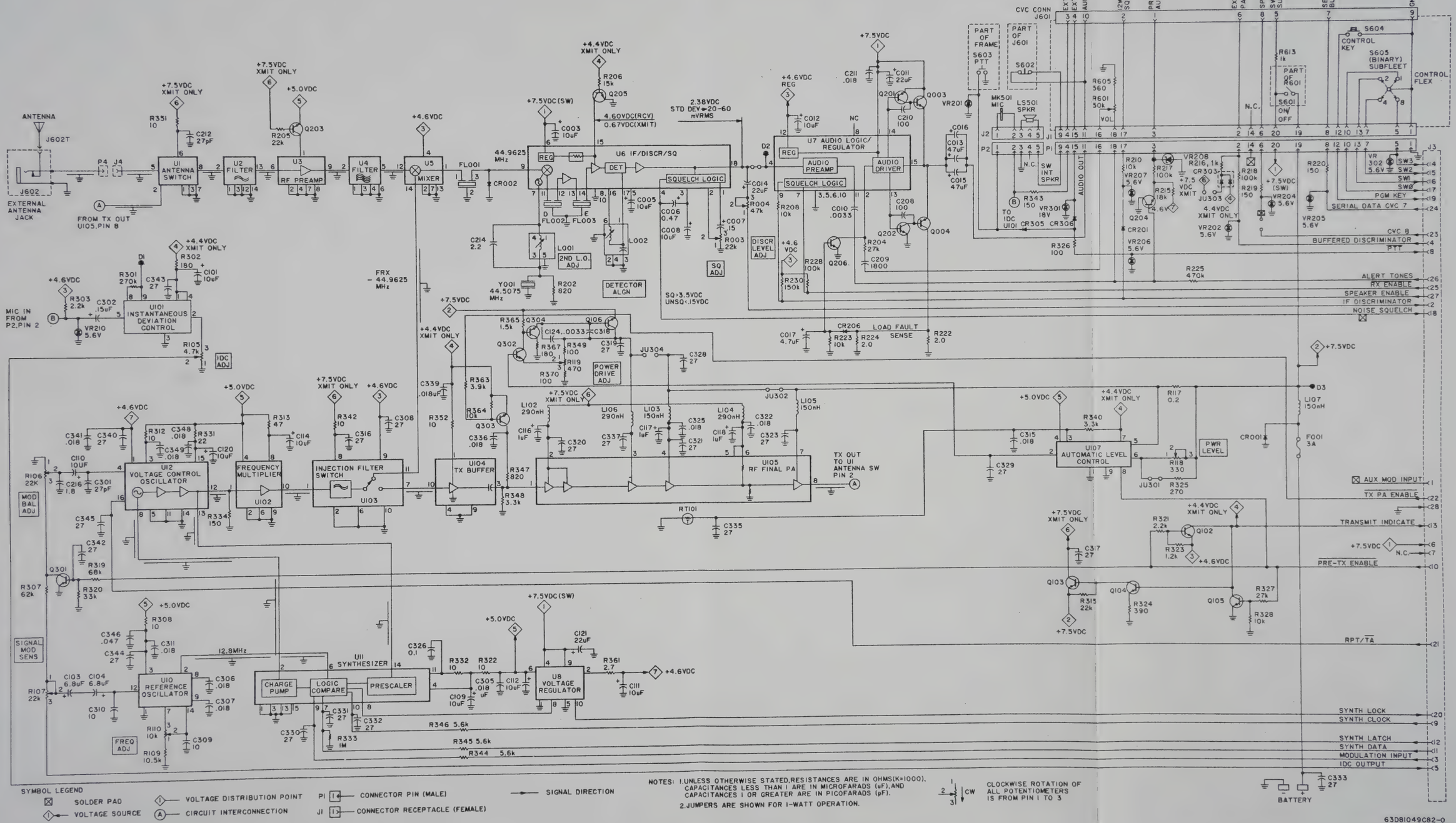


L1-CEPF-17171-0
0L-CEPF-17213-0

NUF6040C AND NUF6050C
Transceiver PCB, Layer 6, With Leadless Component Overlay.
Viewed From Side 2



L6-CEPF-17172-0
0L-CEPF-17174-0



SYMBOL LEGEND

- SOLDER PAD
- VOLTAGE SOURCE
- VOLTAGE DISTRIBUTION POINT
- CIRCUIT INTERCONNECTION
- PI — CONNECTOR PIN (MALE)
- JI — CONNECTOR RECEPTACLE (FEMALE)
- SIGNAL DIRECTION

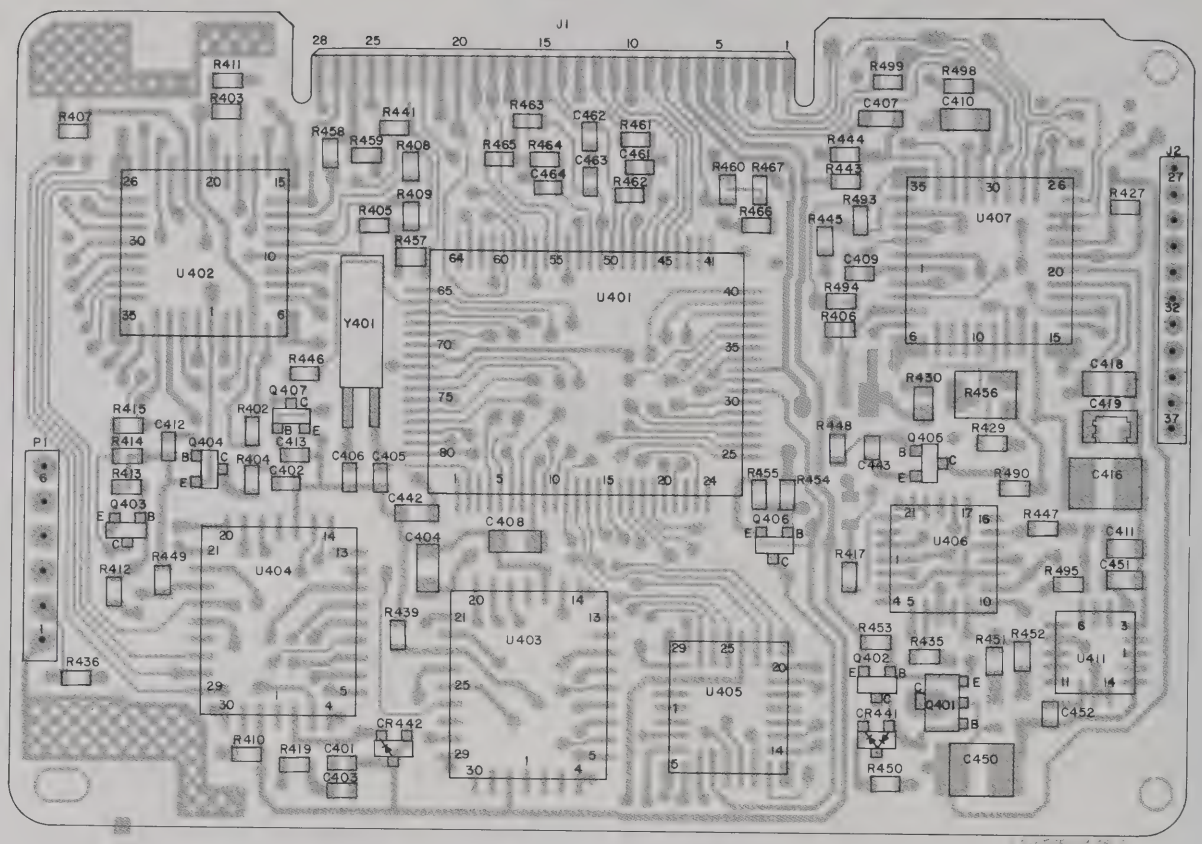
NOTES:
1. UNLESS OTHERWISE STATED, RESISTANCES ARE IN OHMS (K=1000), CAPACITANCES LESS THAN 1 ARE IN MICROFARADS (uF), AND CAPACITANCES 1 OR GREATER ARE IN PICOFARADS (pF).
2. JUMPERS ARE SHOWN FOR 1-WATT OPERATION.

CLOCKWISE ROTATION OF ALL POTENTIOMETERS IS FROM PIN 1 TO 3

63D81049C82-0

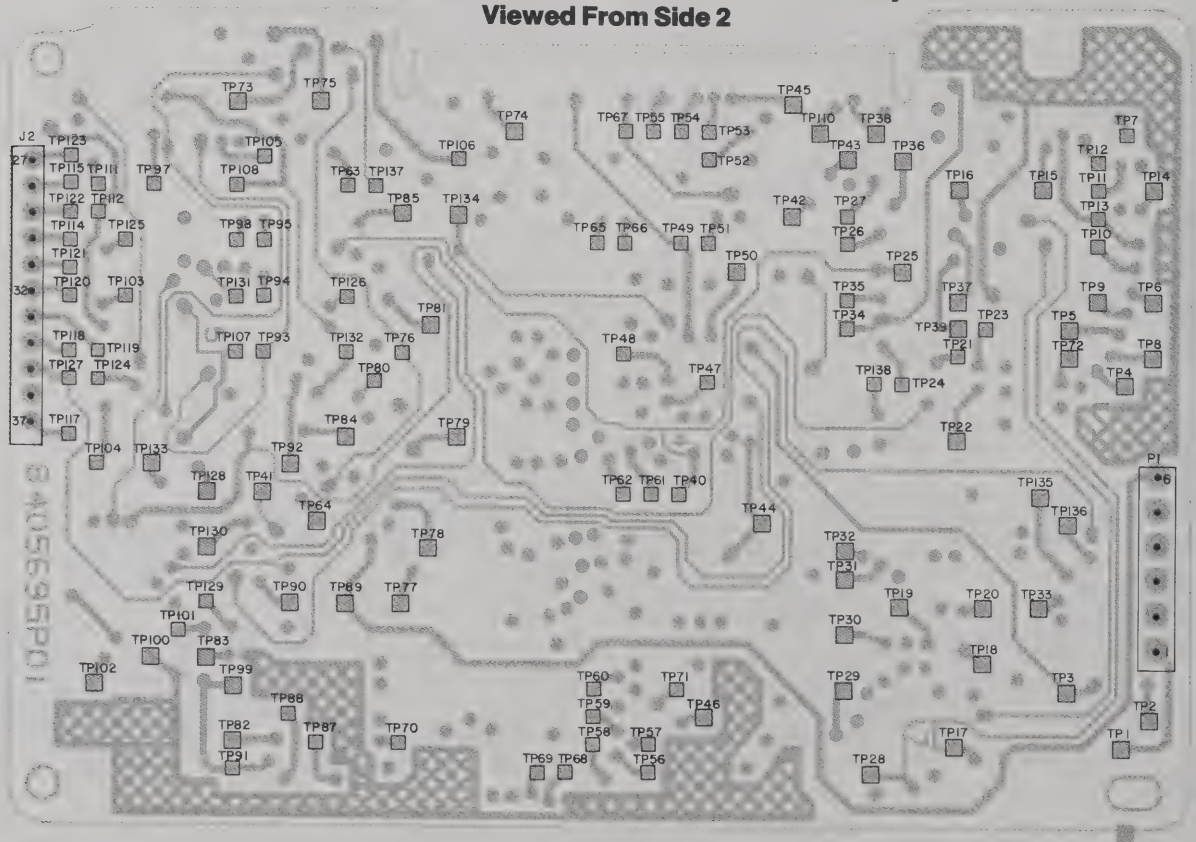
NUF6040C AND NUF6050C TRANSCEIVER SCHEMATIC DIAGRAM

NTN4769A
Controller PCB, Layer 1, With Component Overlay.
Viewed From Side 1

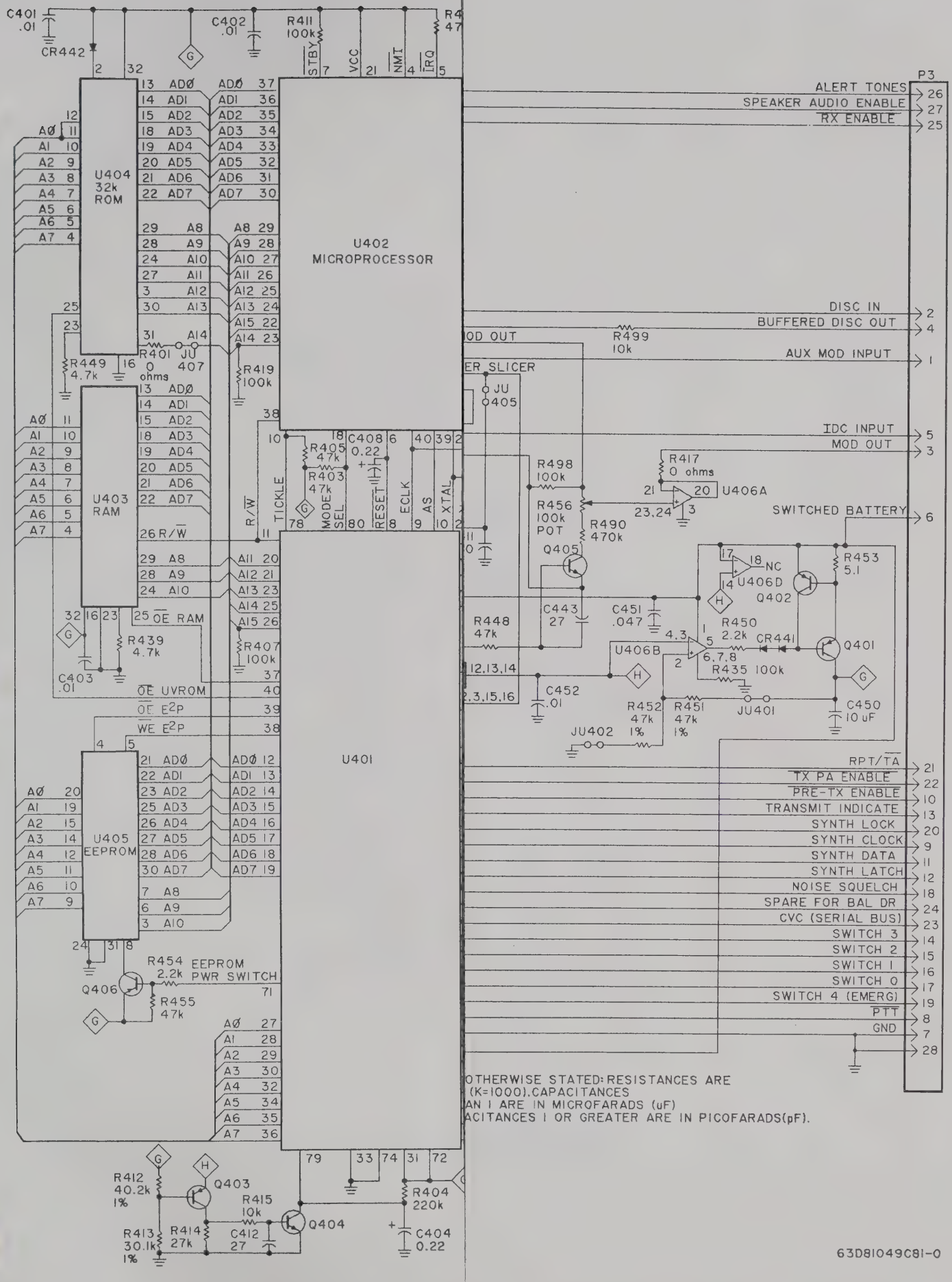


OL-CEPF-17177-0

NTN4769A
Controller PCB, Layer 4, With Test Point Overlay.
Viewed From Side 2



OL-CEPF-17197-0



OTHERWISE STATED: RESISTANCES ARE
(K=1000). CAPACITANCES
AN 1 ARE IN MICROFARADS (uF)
ACITANCES 1 OR GREATER ARE IN PICOFARADS(pF).

63D81049C81-0

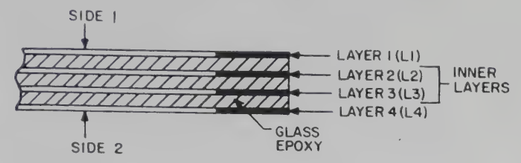
NTN4769A
CONTROLLER BOARD PARTS LIST

TPLF-3443-O

REFERENCE ITEM	MOTOROLA PART NO.	DESCRIPTION
		CAPACITORS: pF ± 5%; 35V unless otherwise stated
C401 thru 403	2160521A25	0.01uF; 25V
C404	2305161K21	0.22uF ± 10%
C405, 406	2160520B03	12
C407	2160521A25	.01uF; 25V
C408	2305161K21	0.22uF ± 10%; 50V
C409	2160521A25	0.01uF; 25V
C410	2305161K21	0.22uF ± 10%
C411	2160520G11	270
C412, 413	2160520B11	27
C416	2305161K24	10uF
C418	2105158A74	0.12uF
C419	2305265B23	1.0uF ± 10%
C442	2160520P07	1800
C443	2160520B11	27
C450	2105161K24	10uF
C451	2160521B33	.047uF; 25V
C452	2160521A25	.01uF; 25V
C461 thru 464	2160520B11	27
		DIODES:
CR441, 442	4805129M06	Silicon
		TRANSISTORS:
Q401	4805128M27	PNP
Q402, 403	4805128M16	PNP
Q404, 405	4805128M44	NPN
Q406	4805128M16	PNP
Q407	4805128M44	NPN
		RESISTORS: Ω ± 5%; unless otherwise stated
R402, 403	0660076A89	47k
R404	0660076B09	220k
R405	0660076A89	47k
R406	0660076A73	10k
R407 thru 409	0660076B01	100k
R411	0660076B01	100k
R412	0660079J69	40.2k ± 1%
R413	0660079J54	30.1k ± 1%
R414	0660076A83	27k
R415	0660076A73	10k
R417	0605021K01	0
R419	0660076B01	100k
R427	0660079J54	30.1k ± 1%
R429	0660076A96	91k
R430	0605021K01	0
R435	0660076B01	100k
R436	0660076A73	10k
R439	0660076A65	4.7k
R441	0605021K01	0
R443	0660079L19	150k ± 1%
R444	0660079K01	73.2k ± 1%
R445	0605021K01	0
R446	0660076B09	220k
R447	0660076B01	100k
R448	0660076A89	47k
R449	0660076A65	4.7k
R450	0660076A57	2.2k
R451, 452	0660079J77	47k ± 1%
R453	0660079U18	5.1 ± 5%
R454	0660076A57	2.2k
R455	0660076A89	47k
R456	1860502A19	100k ± 30% Potentiometer
R457	0660076A65	4.7k
R458, 459	0660076A89	47k
R460	0660076A69	6.8k
R461 thru 467	0660076B01	100k
R490	0660076B17	470k
R493	0660076B09	220k
R494	0660076A57	2.2k
R495	0605021K01	0
R498	0660076B01	100k
R499	0660076A73	10k
		INTEGRATED CIRCUITS:
U401	5105479G22	Gate Array
U402	0105958N10*	uP
U403	0105959L20*	RAM
U404	0105958N05*	ROM
U405	0105950L22	EEPROM
U406	0105959L24*	Dual Op-Amp/Comparator
U407	0105951N03*	Filter IC
U411	0105959L25*	Voltage Reference
		CRYSTAL:
Y401	4805664G22	3.888MHz

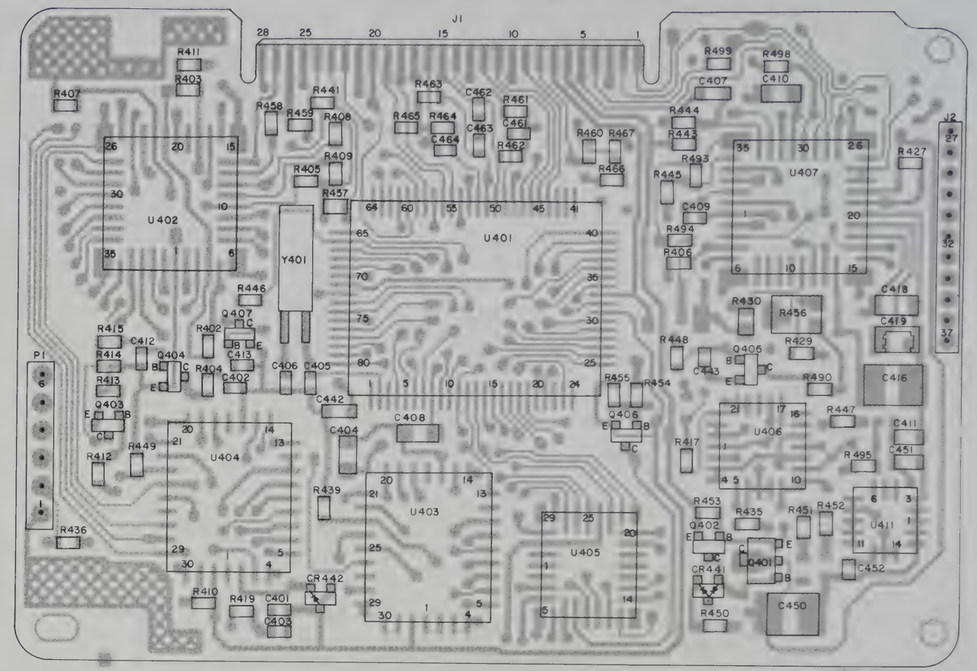
*These chip carriers have solder bumps to facilitate replacement.

4-LAYER CIRCUIT BOARD COPPER DETAIL VIEWING COPPER STEPS AT EDGE OF BOARD IN PROPER LAYER SEQUENCE.



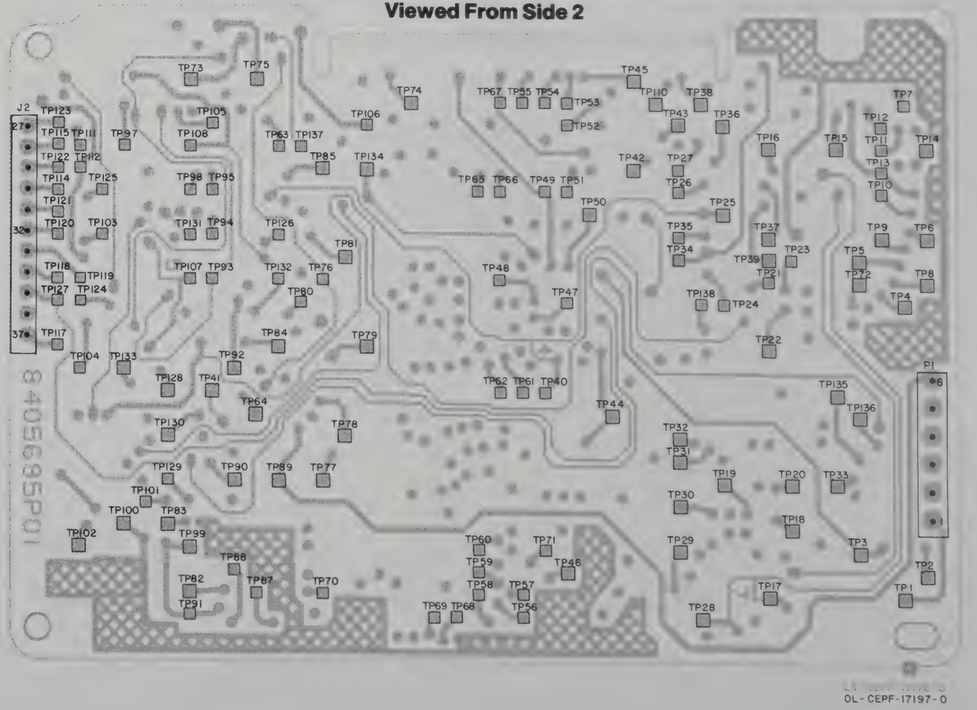
AEPF-16807-0

NTN4769A
Controller PCB, Layer 1, With Component Overlay. Viewed From Side 1

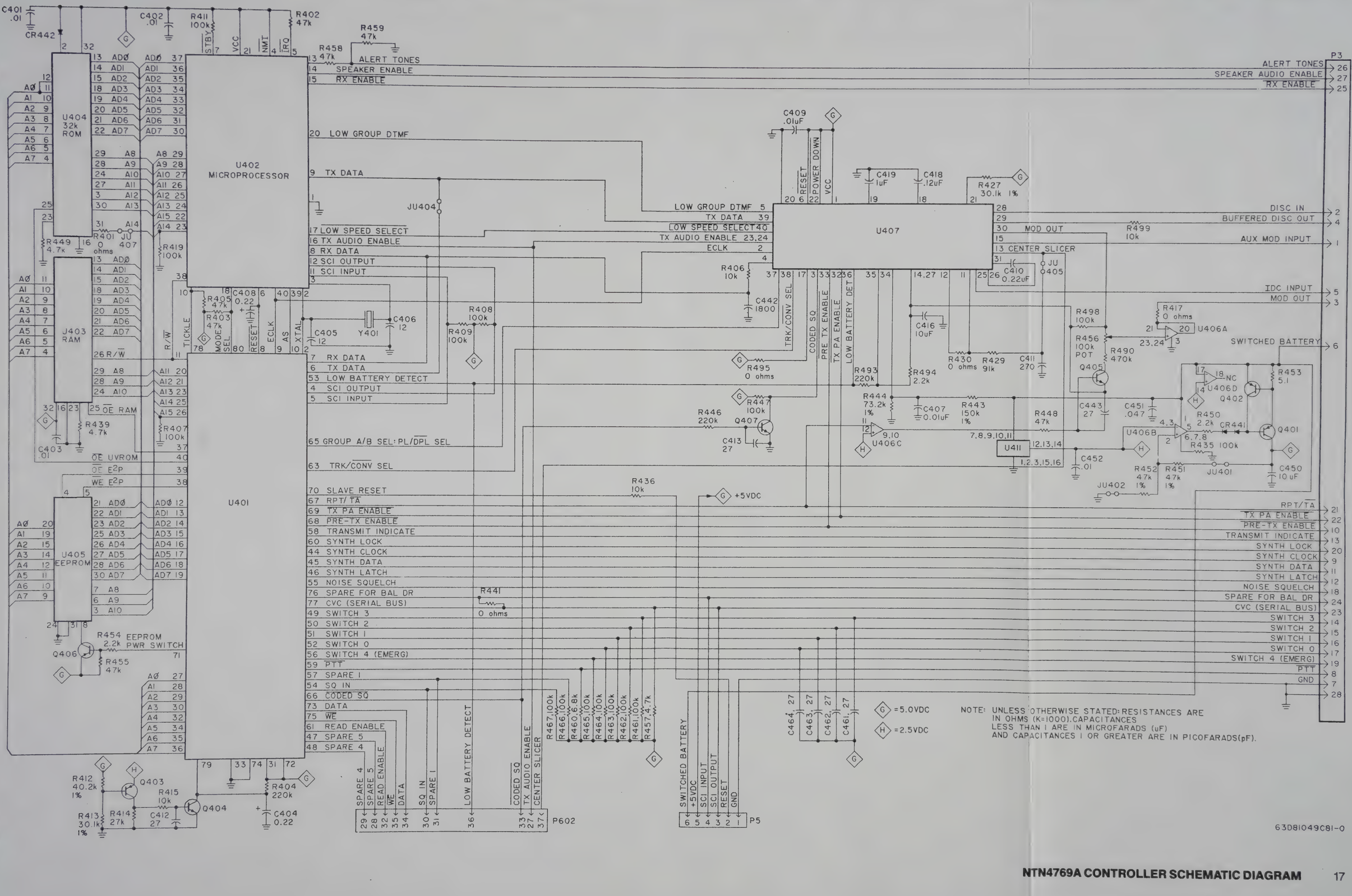


OL-CEPF-17177-0

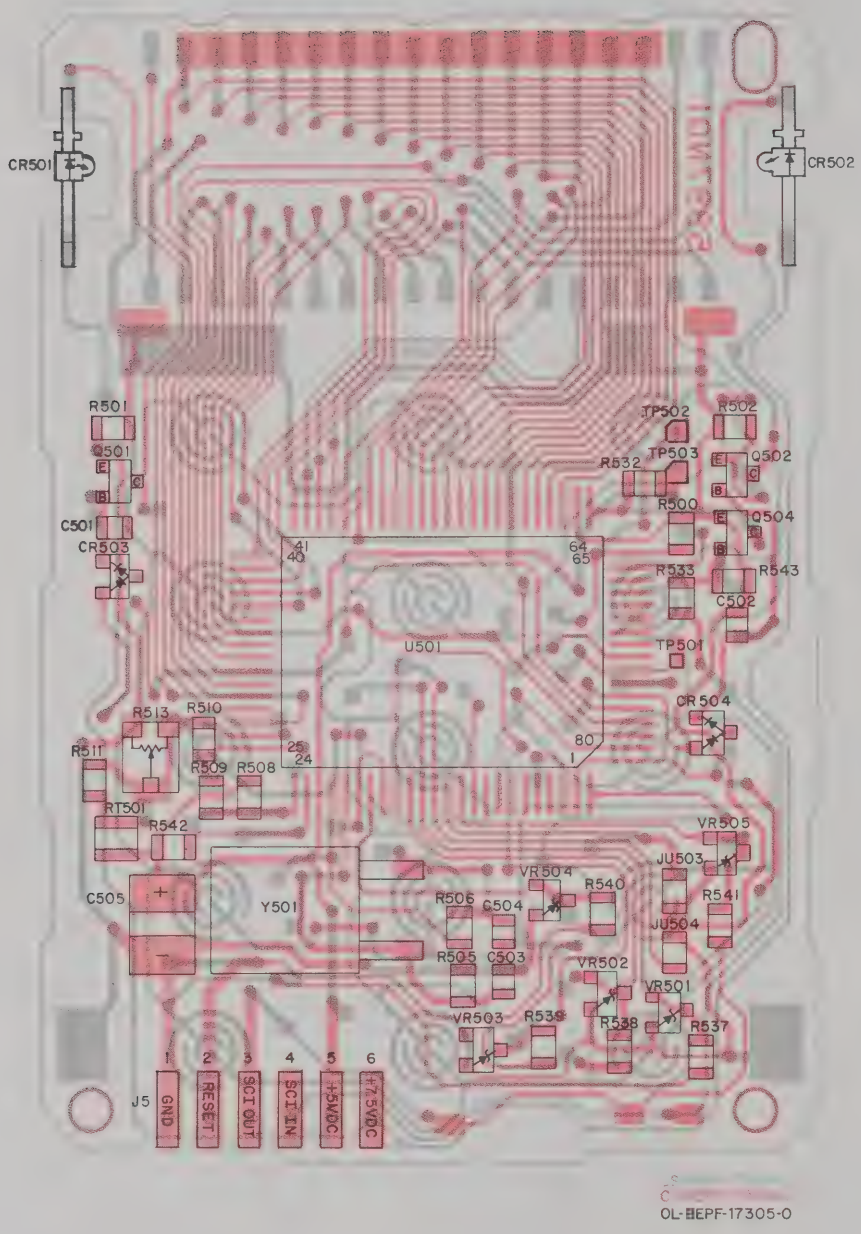
NTN4769A
Controller PCB, Layer 4, With Test Point Overlay. Viewed From Side 2



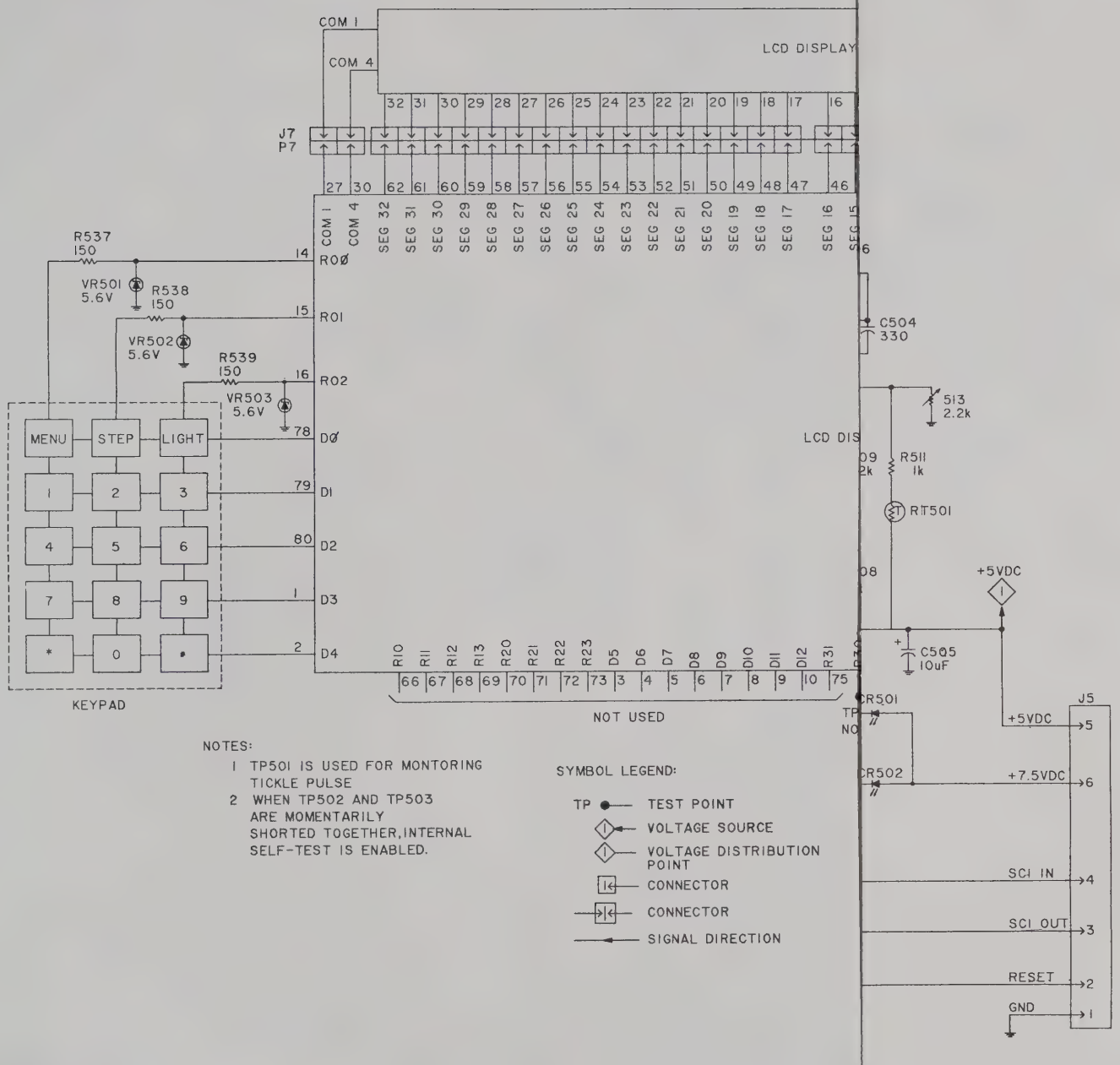
OL-CEPF-17197-0



NOTE: UNLESS OTHERWISE STATED: RESISTANCES ARE IN OHMS (K=1000). CAPACITANCES LESS THAN 1 ARE IN MICROFARADS (uF) AND CAPACITANCES 1 OR GREATER ARE IN PICOFARADS(pF).



Front Cover PCB
Viewed From Solder Side



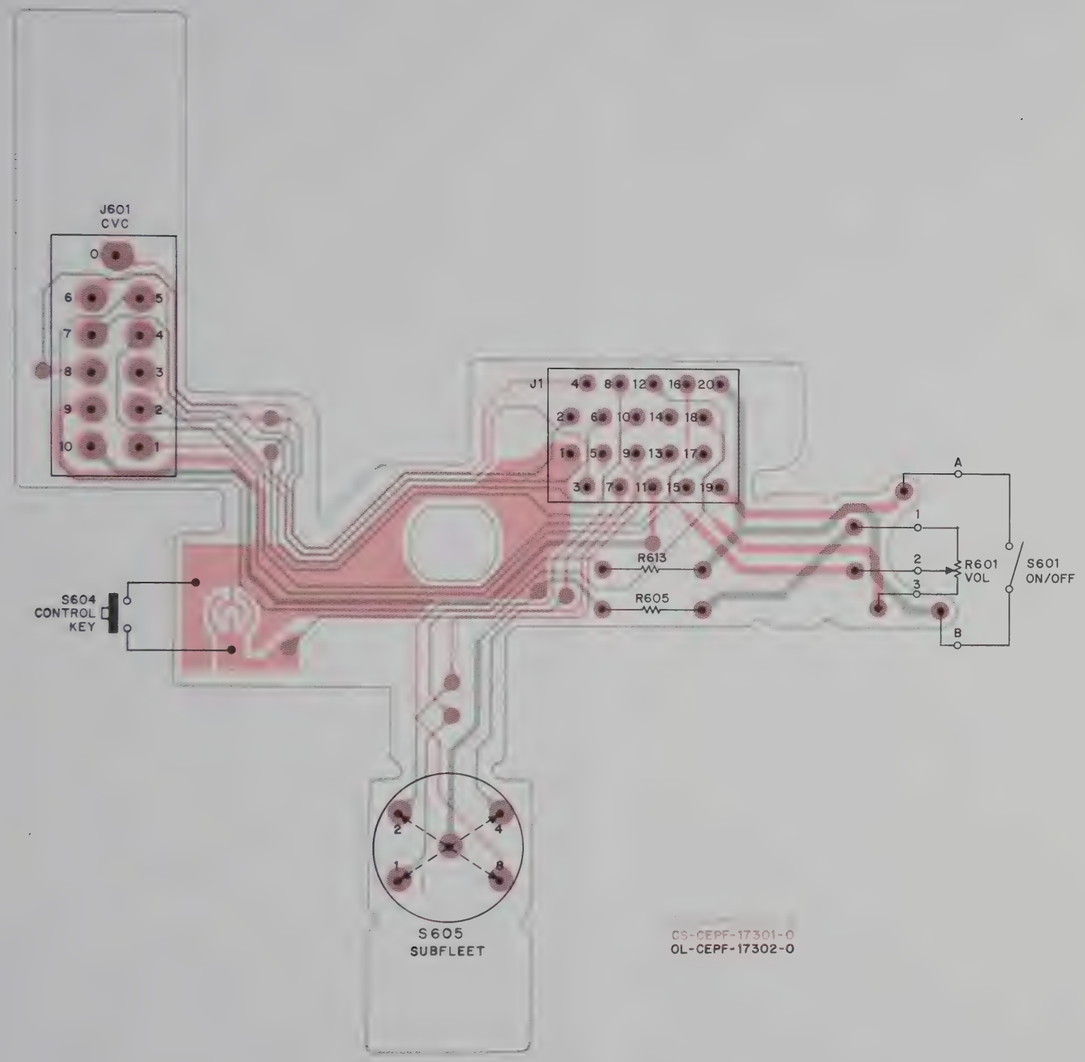
NOTES:

1 TP501 IS USED FOR MONTORING TICKLE PULSE
2 WHEN TP502 AND TP503 ARE MOMENTARILY SHORTED TOGETHER, INTERNAL SELF-TEST IS ENABLED.

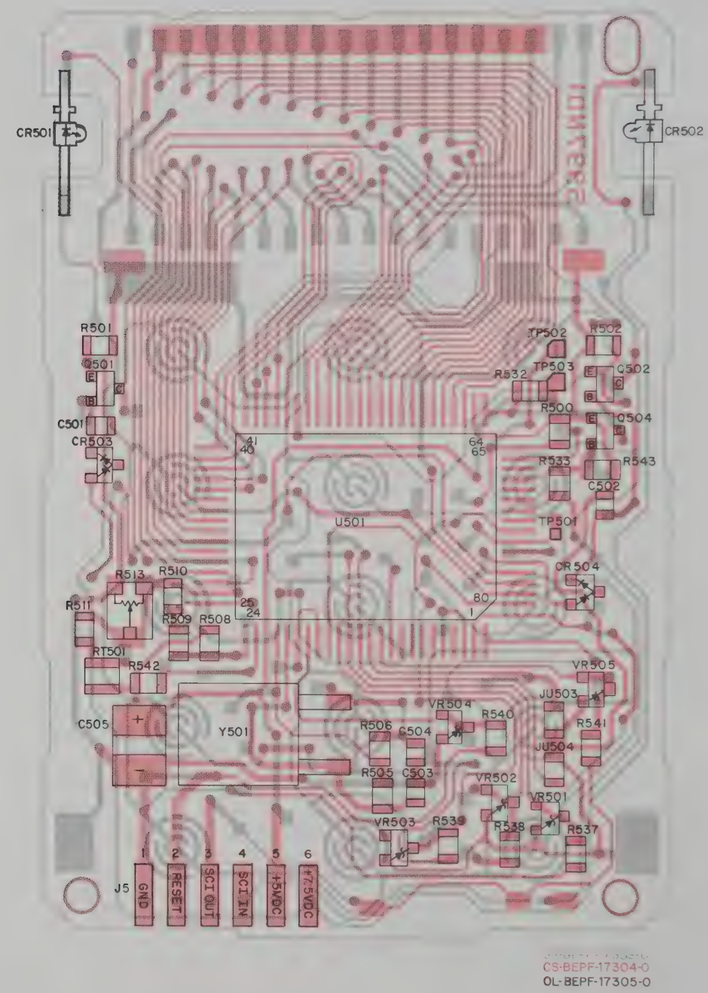
SYMBOL LEGEND:

- TP — TEST POINT
- VOLTAGE SOURCE
- VOLTAGE DISTRIBUTION POINT
- CONNECTOR
- CONNECTOR
- SIGNAL DIRECTION

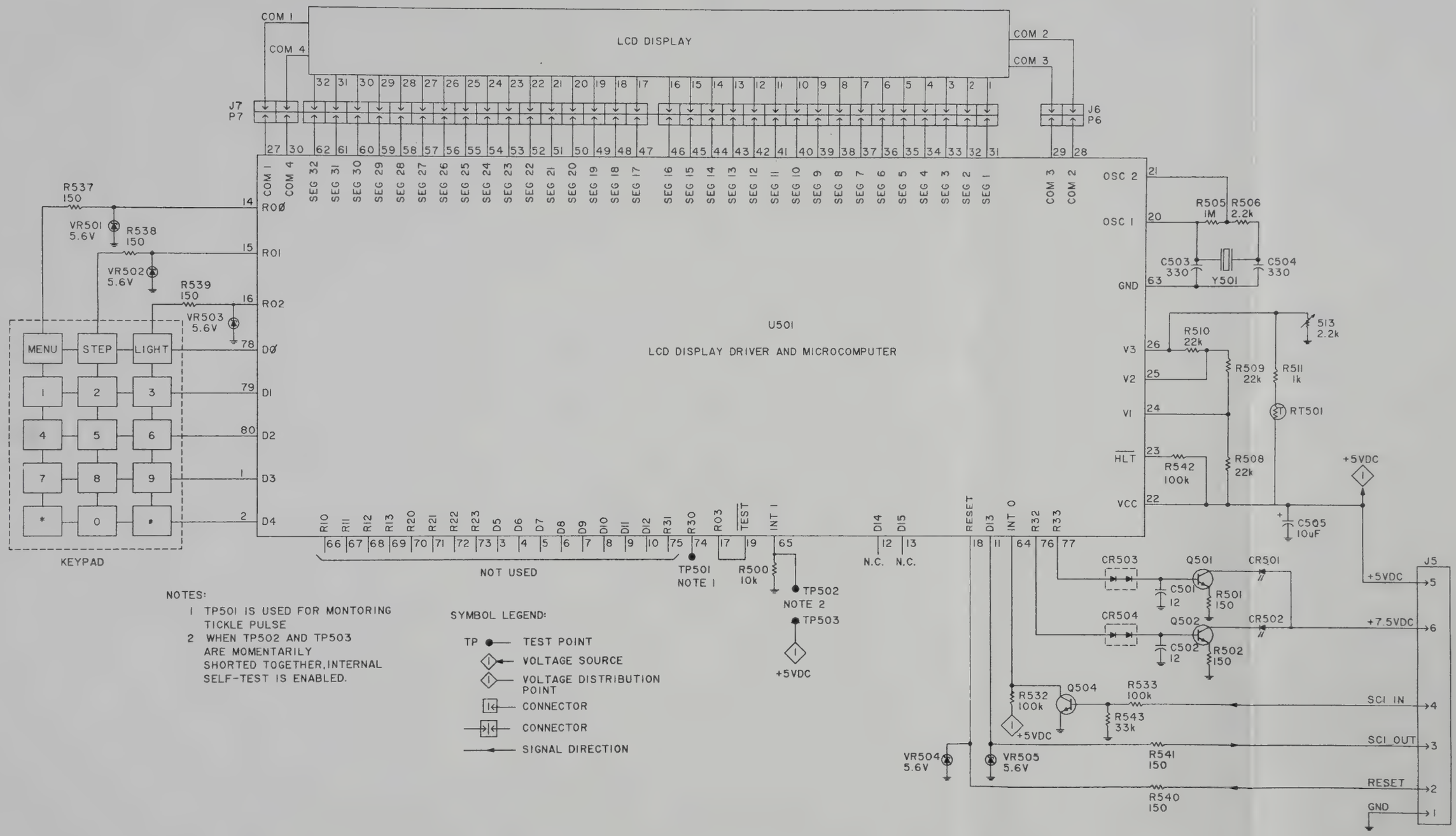
63G81040C28-0

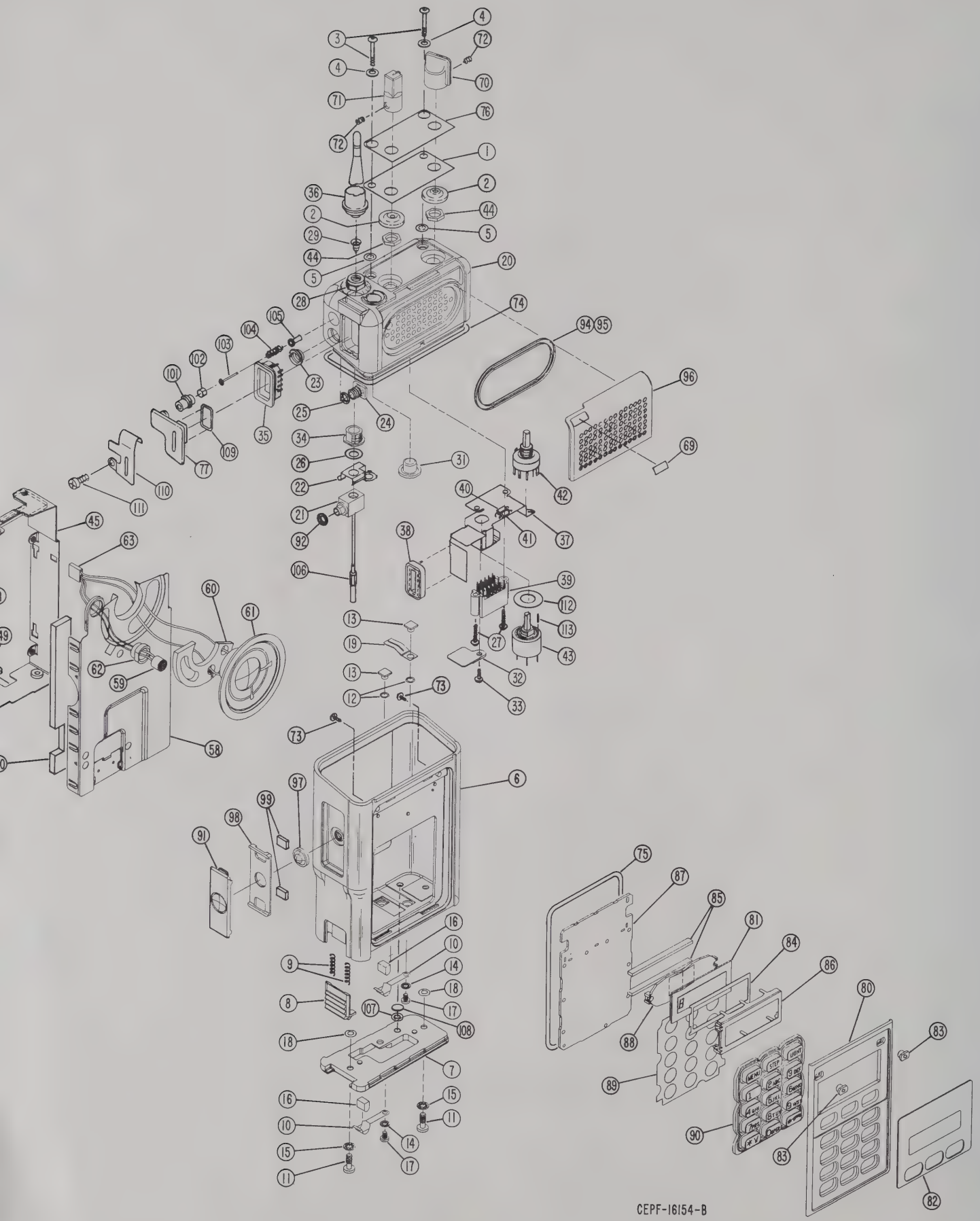


Control-Flex Printed Circuit
Viewed From Component Side



Front Cover PCB
Viewed From Solder Side

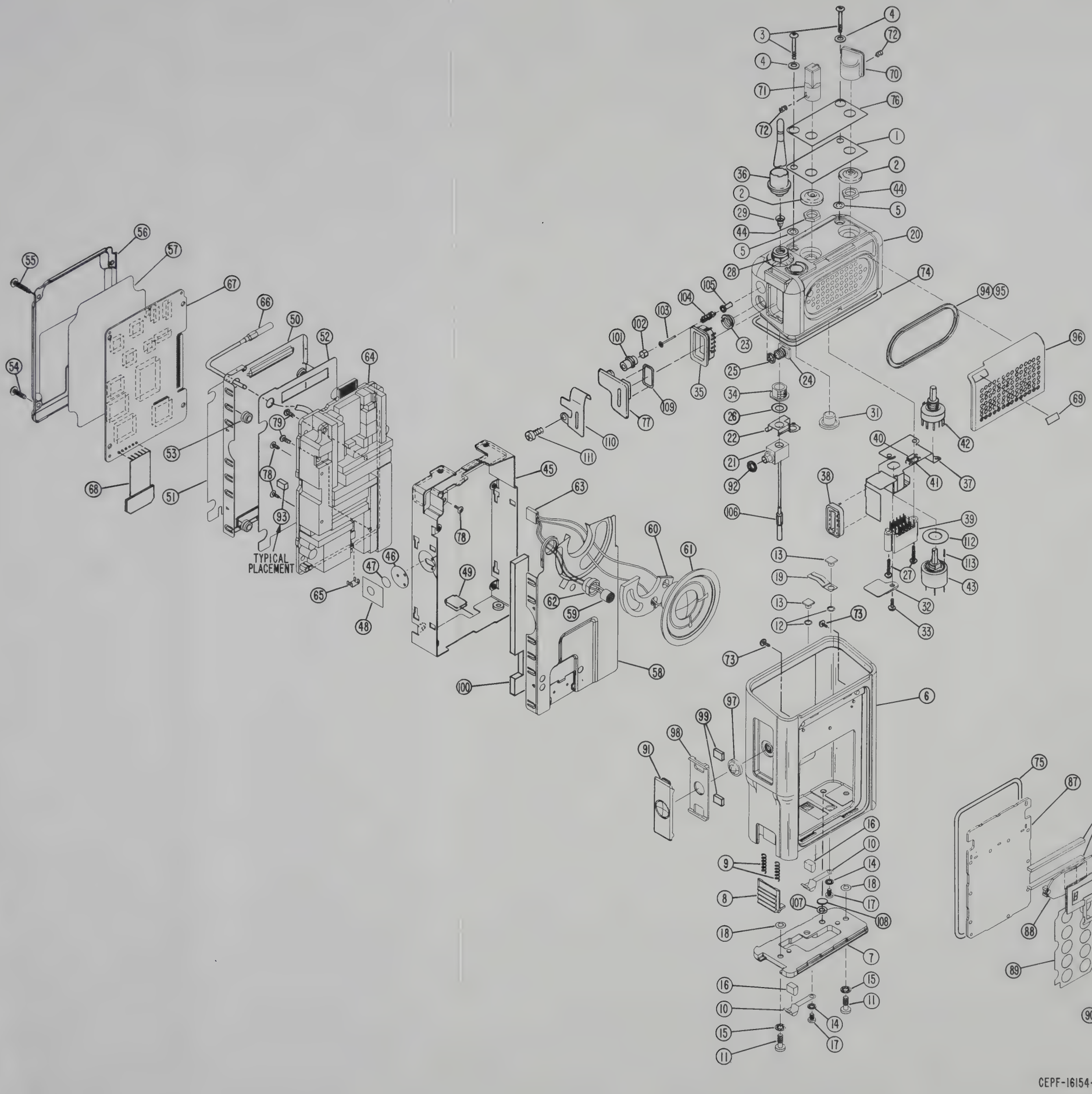

LCD DISPLAY
COM 1
COM 4
COM 2
COM 3
J7
P7
J6
P6
U501
LCD DISPLAY DRIVER AND MICROCOMPUTER
KEYPAD
MENU
STEP
LIGHT
NOT USED
TP501
NOTE 1
TP502
NOTE 2
TP503
+5VDC
N.C.
N.C.
R537 150
VR501 5.6V
R538 150
VR502 5.6V
R539 150
VR503 5.6V
R500 10k
R505 1M
R506 2.2k
C503 330
C504 330
Y501
R510 22k
513 2.2k
R509 22k
R511 1k
RT501
R508 22k
R542 100k
C505 10uF
CR503
CR504
CR501
CR502
Q501
Q502
C501 12
C502 12
R501 150
R502 150
Q504
R532 100k
R533 100k
R543 33k
VR504 5.6V
VR505 5.6V
R541 150
R540 150
SCI IN
SCI OUT
RESET
GND
+7.5VDC
J5
NOTES:
1 TP501 IS USED FOR MONTORING TICKLE PULSE
2 WHEN TP502 AND TP503 ARE MOMENTARILY SHORTED TOGETHER, INTERNAL SELF-TEST IS ENABLED.
SYMBOL LEGEND:
TP TEST POINT
VOLTAGE SOURCE
VOLTAGE DISTRIBUTION POINT
CONNECTOR
CONNECTOR
SIGNAL DIRECTION
63G81040C28-0


CEPF-16154-B

EXPLODED VIEW PARTS LIST

TPLF-3446-O

ITEM NO.	MOTOROLA PART NO.	DESCRIPTION
1	1305462N01	Plate, Escutcheon
2	3205933J02	Seal, Switch (Some models require only one)
3	0305464P01	Screw, Control Top,#4-40 HEXBTN
4	0405683D03	Lockwasher, #4
5	3205082E11	O-Ring
6	0105957K69	Lower Housing Kit (includes items 97 and 98)
7	6405473N01	Baseplate
8	5505727N01	Latch, Battery
9	4105944K01	Spring, Latch
10	3905421C05	Contact, Battery
11	0305941K02	Screw, Baseplate, #4-40
12	3205082E24	O-Ring
13	4605945K03	Bushing, B +
14	0400002625	Lockwasher, #2
15	0400004761	Lockwasher, #4
16	0705830C03	Support, Contact
17	0300138651	Screw, #2-56 × 1/8"PHLPAN
18	3205082E11	O-Ring
19	3905726N01	Contact, B +
20	0105954N65	Upper Housing Kit W/O Rotary Switch (includes items 34 and 94-96)
	0105954N64	Upper Housing Kit W/Rotary Switch (includes items 34 and 94-96)
21	0105957K63	RF Switch; Kit (includes items 22 and 106)
22	0405483P01	Washer, RF Jack
23	0205578M01	Nut, Stud
24	4305577M01	Stud
25	3205082E34	O-Ring, Stud
26	3205639F03	Gasket
27	0300140383	Screw, #2-56 × 9/16"PHLPAN
28	0205588M01	Nut, Antenna Seal
29	0905771F02	Pin, Coaxial
31	3905698N01	Switch, Control
32	6405187P01	Plate, Control Switch
33	0300136782	Screw, #2-56 × 3/16"PHLPAN
34		Bushing, Antenna (Not Field Replaceable; Order item 20)
35	1505673C03	Connector, Side (J601)
36	NAF4000B	Antenna, 800MHz Dipole
37	0105957K62	Control-Flex Kit W/O Rotary Switch (includes items 38-42)
	0105957K66	Control-Flex Kit W/2-Pos. Rotary Switch (includes items 38-43)
	0105957K67	Control-Flex Kit W/8-Pos. Rotary Switch (includes items 38-43)
	0105957K68	Control-Flex Kit W/16-Pos. Rotary Switch (includes items 38-43)
38	0905675C01	Socket
39	0905463Q01	Connector, 20-Pin (J1)
40		Resistor (See Electrical Parts List-R613)
41		Resistor (See Electrical Parts List-R605)
42		Potentiometer, (See Electrical Parts List, R601)
43	4005640Q01	Switch, Subfleet (Optional)
44	0200140458	Nut, Switch
45	0105957K57	Frame Kit (includes items 46-49)
46		PCB, PTT (Not Field Replaceable; order item 45)
47		Contact, Snap-Dome (Not Field Replaceable; order item 45)
48		Seal, Dome (Not Field Replaceable; order item 45)
49	1405026P01	Insulator, B +
50	NTN4344A	Center Shield Kit (includes items 51-53 and 93)
51	1405855N01	Insulator, Logic
52	1405854N01	Insulator, RF
53		Standoff (Not Field Replaceable; order item 50)
54	0305731J07	Screw, #2-56 PHLPAN
55	0305731J06	Screw, #2-56 PHLPAN
56	NTN4519A	Rear Shield Kit (includes item 57)
57	1405302P01	Insulator, Rear
58	2605723N01	Shield, Front
	NTN4511A	Front Shield Kit (includes items 59-63 and 100)
59		Microphone (see Transceiver Board Parts List, MK501)
60	1105477N01	Adhesive, Speaker
61		Speaker (see Transceiver Board Parts List, LS501)
62	7505470N01	Boot, Microphone
63	0905212P02	Connector, Speaker/Mic. (J2)
64	NUF6040C	RF Board, Lo Power (includes items 65, 66, 78 and 79)
	NUF6050C	RF Board, Hi Power (includes items 65, 66, 78 and 79)
65	4205474P01	Clip, B +
66	0905006P01	Plug, Coax, RF
67	NTN4769A	Logic Board (includes item 68)
68	8405758N01	Interconnect, Display
69	3305206P01	Label, Emergency
	3305206P02	Label, Telephone Interconnect
	3305206P03	Label, Volume Set
70	3605295P01	Knob, Volume Switch
71	3605295P02	Knob, Subfleet Switch (used only on Rotary Switch Models)
72	0305480E02	Screw, Set, #4-40 × 3/32"(only one used on Non-Rotary Switch Models)
73	0305304P01	Screw, Front Cover
74	3205082E50	O-Ring, Control-Top
75	3205082E51	O-Ring, Front Cover
76	1305711N01	Escutcheon, Control-Top, Plain
	1305711N02	Escutcheon, Control-Top, 1 Subfleet, 1 TA
	1305711N03	Escutcheon, Control-Top, 2 Subfleet
	1305711N05	Escutcheon, Control-Top, 7 Subfleet, 1 TA
	1305711N06	Escutcheon, Control-Top, 8 Subfleet
	1305711N07	Escutcheon, Control-Top, 8 System
	1305711N08	Escutcheon, Control-Top, 15 Subfleet, 1 TA
	1305711N09	Escutcheon, Control-Top, 16 Subfleet
	1305711N10	Escutcheon, Control-Top, 16 System
77	3205606P01	Seal, Side
78	0300136783	Screw, #2-56 × A5/16"PHLPAN
79	0300139444	Screw, #2-56 × 5/32"PHLPAN
80	NTN4339A	Plain Front Cover Kit (includes items 82 and 83)
	NTN4341A	3-Key Front Cover Kit (includes items 81-90)
	NTN4342A	15-Key Front Cover Kit (includes items 81-90)
	NTN4345A	12-Key Front Cover Kit (includes items 82, 83, 87, 89 and 90)
81	0105952M67	LCD, for 15-Key Cover (includes items 82 and 84-86)
	0105952M68	LCD, for 3-Key Cover (includes items 82 and 84-86)
82	1305954N01	Escutcheon, Front Cover, 3-Key
	1305954N02	Escutcheon, Front Cover, Plain
	1305954N03	Escutcheon, Front Cover, 15-Key
83	0205294P01	Nut, Front Cover
84		Insulator, LCD (Not Field Replaceable; order item 80 or 81)
85		Elastomer, LCD (Not Field Replaceable; order item 80 or 81)
86		Bezel, LCD (Not Field Replaceable; order item 80 or 81)
87		Display Board Kit W/LCD/LED (Not Field Replaceable; order item 80)
		Keyboard Kit W/O LCD/LED/ (Not Field Replaceable; order item 80)
88		Light Pipe, LCD (Not Field Replaceable; order item 80)
89		Shield, Static (Not Field Replaceable; order item 80)
90		Keypad, 3-Key (Not Field Replaceable; order item 80)
		Keypad, 15-Key (Not Field Replaceable; order item 80)
		Keypad, 12-Key (Not Field Replaceable; order item 80)
91	4505722N01	Lever, PTT
92	3205853H02	Gasket
93	7505241B02	Pad, RF
94		Retainer, Membrane (Not Field Replaceable; order item 20)
95		Membrane (Not Field Replaceable; order item 20)
96		Grille, Upper Housing (Not Field Replaceable; order item 20)
97		Actuator, PTT (Not Field Replaceable; order item 6)
98		Retainer, PTT (Not Field Replaceable; order item 6)
99	1105668K35	Pad, Urethane
100	1405784P01	Insulator, Front
101	0205854H01	Nut, Retainer
102	1405664J01	Insulator, Plunger
103	4405829J01	Plunger, RF Switch
104	4105836J01	Spring, RF Switch
105	1405787C01	Insulator, Spring
106	0905006P02	Socket, Coax, RF (P4)
107	3205082E25	O-Ring, Port
108	3205472M01	Seal, Port
109	3205473P04	O-Ring, Side Seal
110	4205241R01	Retainer, Side Seal (Optional)
111	0305731J10	Screw, Captive 6-32 × .190 (Optional)
112	0405487R01	Washer, Adhesive
113	2205386G04	Pin, Stop


TYPICAL PLACEMENT
CEPF-16154-B

EXPLODED VIEW PARTS LIST

TPLF-3446-O

ITEM NO.	MOTOROLA PART NO.	DESCRIPTION
1	1305462N01	Plate, Escutcheon
2	3205933J02	Seal, Switch (Some models require only one)
3	0305464P01	Screw, Control Top,#4-40 HEXBTN
4	0405683D03	Lockwasher, #4
5	3205082E11	O-Ring
6	0105957K69	Lower Housing Kit (includes items 97 and 98)
7	6405473N01	Baseplate
8	5505727N01	Latch, Battery
9	4105944K01	Spring, Latch
10	3905421C05	Contact, Battery
11	0305941K02	Screw, Baseplate, #4-40
12	3205082E24	O-Ring
13	4605945K03	Bushing, B+
14	0400002625	Lockwasher, #2
15	0400004761	Lockwasher, #4
16	0705830C03	Support, Contact
17	0300138651	Screw, #2-56 × 1/8"PHLPAN
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23	0205578M01	Nut, Stud
24	4305577M01	Stud
25	3205082E34	O-Ring, Stud
26	3205639F03	Gasket
27	0300140383	Screw, #2-56 × 9/16"PHLPAN
28	0205588M01	Nut, Antenna Seal
29	0905771F02	Pin, Coaxial
31	3905698N01	Switch, Control
32	6405187P01	Plate, Control Switch
33	0300136782	Screw, #2-56 × 3/16"PHLPAN
34		Bushing, Antenna (Not Field Replaceable; Order item 20)
35	1505673C03	Connector, Side (J601)
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37	0105957K62	Control-Flex Kit W/O Rotary Switch (includes items 38-42)
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	0105957K68	Control-Flex Kit W/16-Pos. Rotary Switch (includes items 38-43)
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39	0905463Q01	Connector, 20-Pin (J1)
40		Resistor (See Electrical Parts List-R613)
41		Resistor (See Electrical Parts List-R605)
42		Potentiometer, (See Electrical Parts List, R601)
43	4005640Q01	Switch, Subfleet (Optional)
44	0200140458	Nut, Switch
45	0105957K57	Frame Kit (includes items 46-49)
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47		Contact, Snap-Dome (Not Field Replaceable; order item 45)
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61		Speaker (see Transceiver Board Parts List, LS501)
62	7505470N01	Boot, Microphone
63	0905212P02	Connector, Speaker/Mic. (J2)
64	NUF6040C	RF Board, Lo Power (includes items 65, 66, 78 and 79)
	NUF6050C	RF Board, Hi Power (includes items 65, 66, 78 and 79)
65	4205474P01	Clip, B+
66	0905006P01	Plug, Coax, RF
67	NTN4769A	Logic Board (includes item 68)
68	8405758N01	Interconnect, Display
69	3305206P01	Label, Emergency
	3305206P02	Label, Telephone Interconnect
	3305206P03	Label, Volume Set
70	3605295P01	Knob, Volume Switch
71	3605295P02	Knob, Subfleet Switch (used only on Rotary Switch Models)
72	0305480E02	Screw, Set, #4-40 × 3/32"(only one used on Non-Rotary Switch Models)
73	0305304P01	Screw, Front Cover
74	3205082E50	O-Ring, Control-Top
75	3205082E51	O-Ring, Front Cover
76	1305711N01	Escutcheon, Control-Top, Plain
	1305711N02	Escutcheon, Control-Top, 1 Subfleet, 1 TA
	1305711N03	Escutcheon, Control-Top, 2 Subfleet
	1305711N05	Escutcheon, Control-Top, 7 Subfleet, 1 TA
	1305711N06	Escutcheon, Control-Top, 8 Subfleet
	1305711N07	Escutcheon, Control-Top, 8 System
	1305711N08	Escutcheon, Control-Top, 15 Subfleet, 1 TA
	1305711N09	Escutcheon, Control-Top, 16 Subfleet
	1305711N10	Escutcheon, Control-Top, 16 System
77	3205606P01	Seal, Side
78	0300136783	Screw, #2-56 × A5/16"PHLPAN
79	0300139444	Screw, #2-56 × 5/32"PHLPAN
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	NTN4342A	15-Key Front Cover Kit (includes items 81-90)
	NTN4345A	12-Key Front Cover Kit (includes items 82, 83, 87, 89 and 90)
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	0105952M68	LCD, for 3-Key Cover (includes items 82 and 84-86)
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	1305954N02	Escutcheon, Front Cover, Plain
	1305954N03	Escutcheon, Front Cover, 15-Key
83	0205294P01	Nut, Front Cover
84		Insulator, LCD (Not Field Replaceable; order item 80 or 81)
85		Elastomer, LCD (Not Field Replaceable; order item 80 or 81)
86		Bezel, LCD (Not Field Replaceable; order item 80 or 81)
87		Display Board Kit W/LCD/LED (Not Field Replaceable; order item 80)
		Keyboard Kit W/O LCD/LED/ (Not Field Replaceable; order item 80)
88		Light Pipe, LCD (Not Field Replaceable; order item 80)
89		Shield, Static (Not Field Replaceable; order item 80)
90		Keypad, 3-Key (Not Field Replaceable; order item 80)
		Keypad, 15-Key (Not Field Replaceable; order item 80)
		Keypad, 12-Key (Not Field Replaceable; order item 80)
91	4505722N01	Lever, PTT
92	3205853H02	Gasket
93	7505241B02	Pad, RF
94		Retainer, Membrane (Not Field Replaceable; order item 20)
95		Membrane (Not Field Replaceable; order item 20)
96		Grille, Upper Housing (Not Field Replaceable; order item 20)
97		Actuator, PTT (Not Field Replaceable; order item 6)
98		Retainer, PTT (Not Field Replaceable; order item 6)
99	1105668K35	Pad, Urethane
100	1405784P01	Insulator, Front
101	0205854H01	Nut, Retainer
102	1405664J01	Insulator, Plunger
103	4405829J01	Plunger, RF Switch
104	4105836J01	Spring, RF Switch
105	1405787C01	Insulator, Spring
106	0905006P02	Socket, Coax, RF (P4)
107	3205082E25	O-Ring, Port
108	3205472M01	Seal, Port
109	3205473P04	O-Ring, Side Seal
110	4205241R01	Retainer, Side Seal (Optional)
111	0305731J10	Screw, Captive 6-32 × .190 (Optional)
112	0405487R01	Washer, Adhesive
113	2205386G04	Pin, Stop

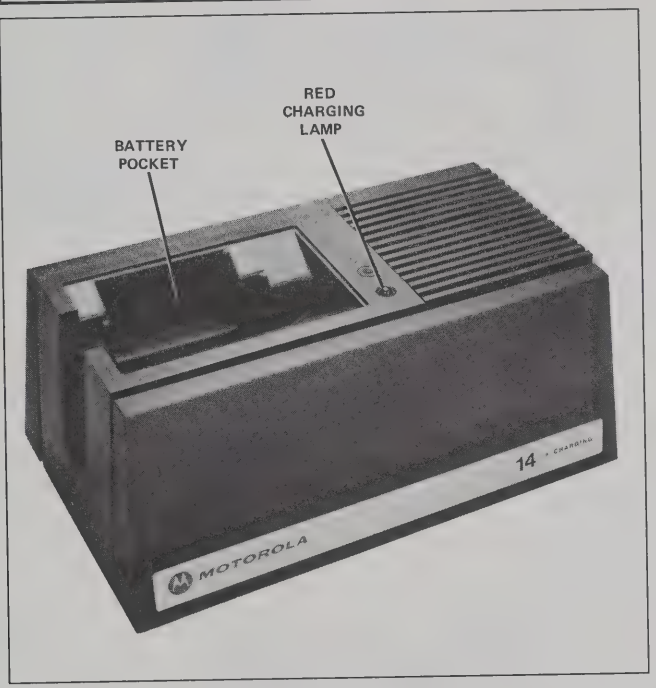
MOTOROLA

14-HOUR SINGLE-UNIT BATTERY CHARGERS

MODEL NLN8856A (115Vac)
MODEL NLN4036A (230Vac)

SPECIFICATIONS

Charging Time	14 hours
Input Voltage	115 or 230Vac (+20% – 10%), 50-60Hz
Capacity	One radio with nickel-cadmium battery or one battery
Operating Temperature Range	+5°C to +40°C (+40°F to +104°F)
Dimensions	3.7 in. high, 5.2 in. wide, 8.1 in. long (94 × 132 × 205mm)
Weight	3 lbs, 3 oz (1445 grams)



NOTE

The radio receiver may be operated while attached to a battery being recharged in the charger.

1. OPERATION

a. Plug the charger into the proper ac receptacle; 115V or 230V, 50-60Hz, depending on the model.

b. Insert any of the available batteries, with or without the radio attached, into the charger pocket. The battery contacts must mate with the fingers in the pocket. If reversed, the charger will not operate.

c. Observe that the red lamp glows on the charger. This indicates that the battery is charging.

d. Remove the battery after 14 hours. If desired, the battery may be left in the charger indefinitely.

NOTE

The charger may be left connected to ac power at all times.

2. CIRCUIT DESCRIPTION

This battery charger will recharge any nickel-cadmium twist-off battery for the MX300 series radio in 14 hours, with or without the radio attached.

Operating B+ is developed from a step-down transformer (T1), with a fused primary, driving a full-wave rectifier bridge (CR1-CR4). The charging current for the battery is through R3, Q1, and CR6 from the B+ supply. All other circuits control the current and light the LED indicator.

All MX300 series twist-off batteries contain an internal resistor (R_R) which identifies the charging current required for that size battery. This resistor determines the reference voltage at the base of Q1 and therefore the current supplied through Q1 to the battery. A lower value R_R results in a lower (less positive) output at pin 2 of the regulator, which increases the current through Q1 to the battery.

When the battery is inserted into the pocket, charging current through CR6 to the battery turns on Q2. This applies operating voltage to LED indicator CR7.

3. ADJUSTING R2 FOR CHARGING CURRENT

NOTE

Potentiometer R2 provides a fine control for adjusting charging current to the battery. This control is factory set and should not require adjusting unless parts are replaced.

a. Connect a digital voltmeter across R3. Without a battery in the charger, the voltage should be zero Vdc.

b. Insert a discharged battery into the pocket.

c. Refer to the "DC VOLTAGE MEASUREMENTS" chart and adjust R2 for the voltage indicated in the column titled "Across R3."

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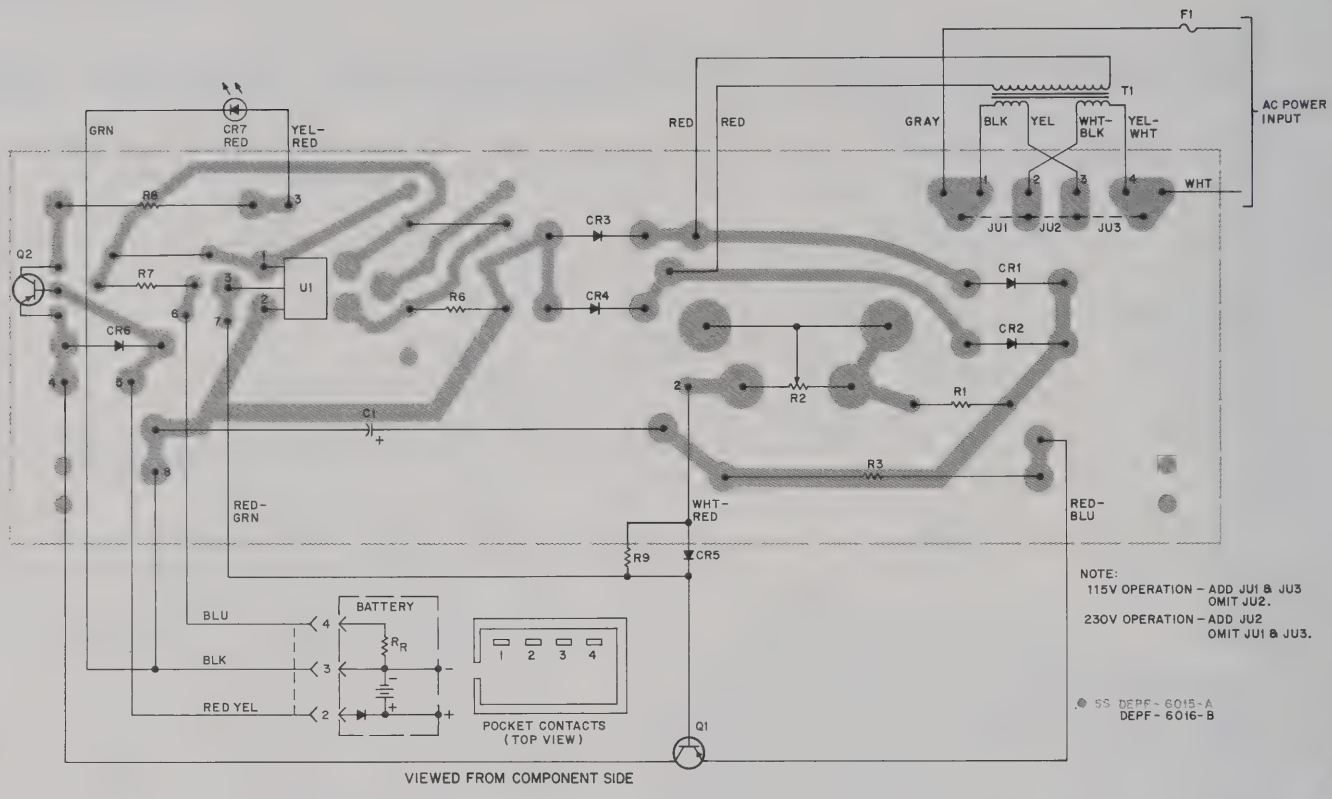
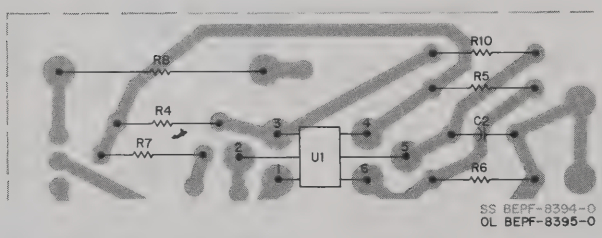
Instruction Manual
68P81101C50-C

CIRCUIT BOARD DETAILS
NLN8856A-3 & LATER
NLN4036A-3 & LATER



NLN8856A-2 & EARLIER
NLN4036A-2 & EARLIER



DC VOLTAGE MEASUREMENTS

BATTERY	LOCATION									Charging Current (Nominal)
	C1	Across R3	Q1 Emitter	Q1 Collector	Q1 Base	Q2 Collector	CR7	Pin 4 Battery	U1 *Pin 1	
NO BATTERY	21.0	0	21.0	21.0	20.0	0.0	0	5.0	5.0	0
NLN8831 NLN8834	19.5	0.20 0.40	19.0	10.0	18.8	10.0	2.0	4.62	5.0	67 mA 91 mA
NLN8832 NLN8835	19.0	0.40 0.60	18.1	10.1	17.8	10.1	2.0	4.1	4.9	130 mA 178 mA
NLN8833	17.0	0.70	15.8	10.2	15.0	10.1	2.0	2.6	4.9	255 mA

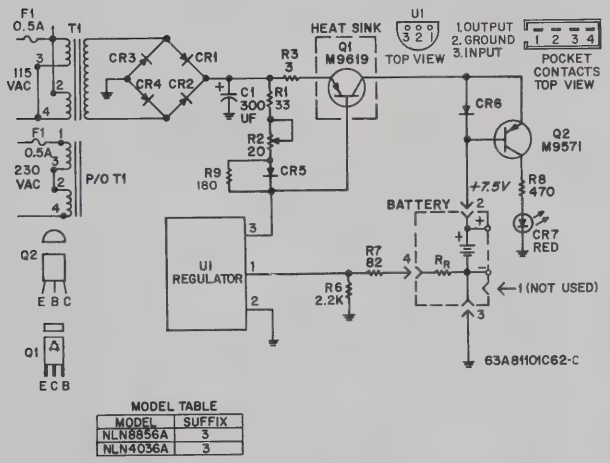
NOTES:

1. All voltages are typical, measured with a Motorola S1063A Multimeter from given location to common ground except for the voltage measured across R3.
2. Input is nominal 115 Vac, 60 Hz.

*Pin 4 on models suffixed: NLN8856A-2 & Earlier
NLN4036A-2 & Earlier

EPF-8534-O

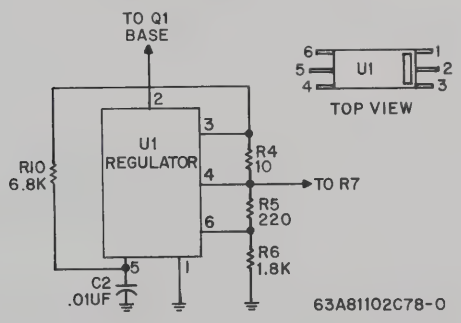
SCHEMATIC DIAGRAM
NLN8856A-3 & LATER
NLN4036A-3 & LATER



MODEL TABLE

MODEL	SUFFIX
NLN8856A	3
NLN4036A	3

NLN8856A-2 & EARLIER
NLN4036A-2 & EARLIER



PARTS LIST

14-Hour Charger
NLN8856A (115V)
NLN4036A (230V)

TPLF-925-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, Fixed:
C1	2382077C14	300uF; 40V
		DIODE: See Note
CR1 thru 6	4882466H13	Silicon
CR7	4805776C01	LED, Red
		FUSE:
F1	6500021975	½ Amp.
		TRANSISTOR: See Note
Q1	4800869619	PNP; type M9619
Q2	4800869571	PNP; type M9571
		RESISTOR, Fixed: Ω ± 5% ¼W unless stated
R1	0611009C13	33
R2	1883168C10	pot; 20
R3	1782177B01	3; 5W, wirewound
R6	0611009C57	2.2k
R7	0611009C23	82
R8	0600126C41	470 ± 10%
R9	0611009C25	100 ± 5%
		TRANSFORMER:
T1	2505726C01	Power; resistance, lead 1 to 2: 105Ω, lead 3 to 4: 115Ω, lead 5 to 6: 0.72Ω
		INTEGRATED CIRCUIT:
U1	5105469E01	Voltage Regulator
NONREFERENCED ITEMS		
	5482499J02	LABEL, Fuse
	5482500J01	LABEL, Shock Hazard

NOTE: For optimum performance, order replacement diodes and transistors by Motorola part number only.

REVISIONS

BOARD AND SUFFIX NO.	REFERENCE SYMBOL	CHANGE
NLN8856A-1	R10	Added
NLN4036A-1	R1	Was 0600124A09, 22Ω
NLN8856A-2	R6	Was 0600124A55, 1.8kΩ
NLN4036A-2	U1	Was 5184320A69, voltage regulator; type M2069
NLN8856A-3 NLN4036A-3	C2	Deleted, Was 2182428B59 .01uF – 20 + 80%; 200V
	R4	Deleted, Was 0600124A01, 10Ω
	R5	Deleted, Was 0600124A33, 220Ω
	R10	Deleted, Was 0600124C69, 6.8k

PARTS LIST

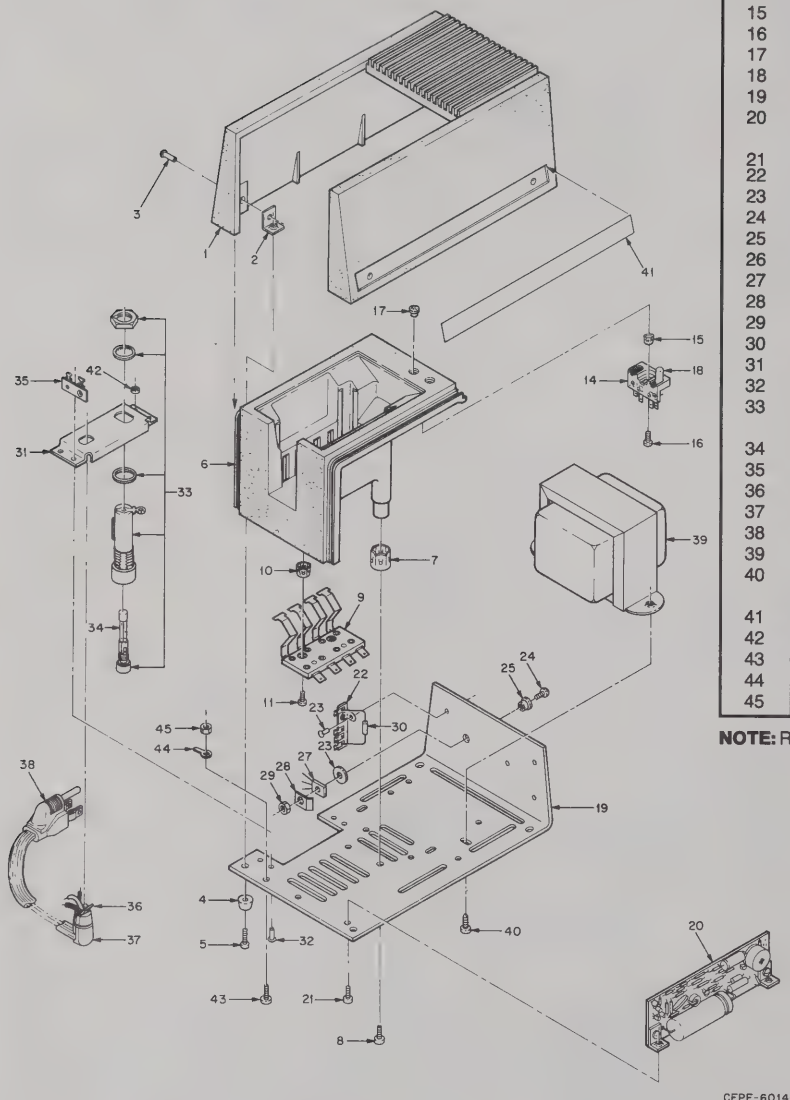
14-Hour Charger Exploded View Parts List
NLN8856A (115V)
NLN4036A (230V)

TPLF-924-B

ITEM NO.	NOMENCLATURE	MOTOROLA PART NO.
1	HOUSING	1505714C01
2	BRACKET	0705712C01
3	RIVET, .145 × 7/32	0500136236
4	BUMPER, Rubber	7584660H01
5	SCREW, Phillips Hd; 6-32 × 1/2"	0300488006
6	HOUSING	1505715C01
7	CLIP, Fastener	4205722C02
8	SCREW, Tapping; Slotted Pan Hd; 8-32 × 3/8"	0300138574
9	ASSEMBLY, Contact	0105956B60
10	CLIP, Fastener	4205722C01
11	SCREW, Phillips Hd; 4-40 × 1/4"	0300136774
12	Not Used	-----
13	Not Used	-----
14	ASSEMBLY, LED Holder	0105958B05
15	CLIP, Fastener	4205722C01
16	SCREW, Phillips Hd; 4-40 × 1/4"	0300136774
17	PLUG, LED	2805782C01
18	DIODE, LED; CR7	See Note
19	BASE Plate	6405823C01
20	ASSEMBLY, Circuit Board and Electrical Component	0105957B20
21	SCREW, Phillips Hd; 6-32 × 3/8"	0300121103
22	STRIP, Terminal; 4-contact	3100135392
23	RIVET, .122 × 3/16	0500122212
24	SCREW, Phillips Hd; 4-40 × 1/2"	0300136998
25	WASHER, Shoulder	1400857512
26	WASHER, Insulator	0405825C01
27	TRANSISTOR, Q1	See Note
28	CLIP	4205933C01
29	NUT, Hex; 4-40 × 1/4" × 3/32"	0200007019
30	DIODE, CR5	See Note
31	BRACKET	0705711C01
32	RIVET, Semi.-Tube; .149 × 9/32"	0500120607
33	RECEPTACLE, Fuse Holder, Washer, and Nut	0905724C02
34	FUSE, F1	See Note
35	STRIP, Terminal; 2-contact	3100120174
36	SPACER	4305233D01
37	RETAINER, Cable	4205723C01
38	AC CORD & CABLE	3082494J06
39	TRANSFORMER, T1	See Note
40	SCREW, Tapping; slotted Pan Hd; 8-32 × 3/8"	0300138574
41	NAMEPLATE	3305781C03
42	WASHER, Flat	0400007569
43	SCREW, Mch; 4-40 × 3/8"	0300400106
44	LUG	2900005293
45	NUT, Hex	0200007019

NOTE: Refer to electrical parts list for component value and part number.

EXPLODED VIEW



CEPF-6014-B

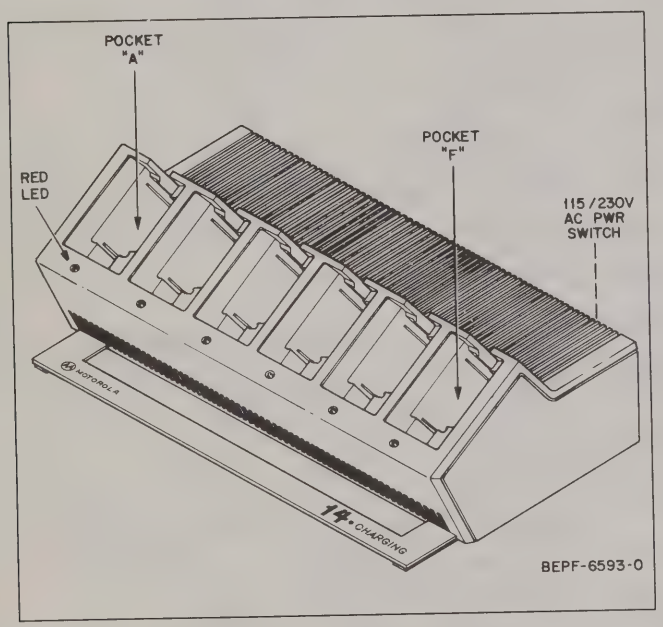
MOTOROLA

14-HOUR MULTIPLE-UNIT BATTERY CHARGER

Models NLN8990A and NTN4832A For MX300 & STX SERIES RADIOS

SPECIFICATIONS

Charging Time	14 hours
Input Voltage	115 or 230Vac (+20% – 10%) 50-60Hz
Capacity (Maximum)	Six MX300/STX Series radios with nickel-cadmium battery or six batteries.
Operating Temperature Range	+5°C to +40°C (+40°F to +104°F)
Dimensions	6.5 in. high, 9.6 in. wide, 17.6 in. long (165 × 244 × 447mm)
Weight	12.5 lbs. (5676 grams)



NOTE

The radio receiver may be operated while attached to a battery being recharged in the charger.

1. OPERATION

a. Set switch S1 to the available ac power; 115V or 230V, 50 or 60Hz. Plug the charger into the ac power receptacle.

NOTE

For 230V operation, the plug on the charger must be replaced.

b. Insert any of the available batteries, with or without the radio attached, into any charger pocket. The battery contacts must mate with the fingers in the pocket. If reversed, the charger will not operate.

c. Observe that the red lamp glows beside the pocket. This indicates that the battery is charging.

d. Remove the battery after 14 hours. If desired, the battery may be left in the charger indefinitely.

NOTE

The charger may be left connected to ac power at all times.

2. CIRCUIT DESCRIPTION

This battery charger will simultaneously recharge up to six nickel-cadmium twist-off/slide-off batteries for the MX300/STX Series radios in 14 hours, with or without the radio attached.

NOTE

The batteries used with the STX Series "slide-off," instead of the "twist-off" type used with the MX300 Series.

Operating B+ is developed from a step-down transformer (T1), with a fused primary, driving a full-wave rectifier bridge (CR1). The charging current for the battery is through R3, Q1, and CR6 from the B+ supply. All other circuits control the current and light the LED indicator.

All MX300 Series twist-off batteries contain an internal resistor (R_R) which identifies the charging current required for that size battery. This resistor determines the reference voltage at the base of Q1 and therefore the current supplied through Q1 to the battery. A lower value R_R results in a lower (less positive) output at pin 2 of the regulator, which increases the current through Q1 to the battery.

When the battery is inserted into the pocket, charging current through CR6 to the battery turns on Q2. This applies operating voltage to LED indicator CR7.

3. ADJUSTING R2 FOR CHARGING CURRENT

NOTE

Potentiometer R2 provides a fine control for adjusting charging current to the battery. This control is factory set and should not require adjusting unless parts are replaced.

a. Connect a digital voltmeter across R3. Without a battery in the charger, the voltage should be zero Vdc.

b. Insert a discharged battery into pocket A.

c. Refer to the "DC VOLTAGE MEASUREMENTS" chart included in th ese instructions and adjust R2 for the voltage indicated in the column titled "Across R3."

d. Repeat steps a. through c. for each of the 5 remaining pockets, using R102 - R502.

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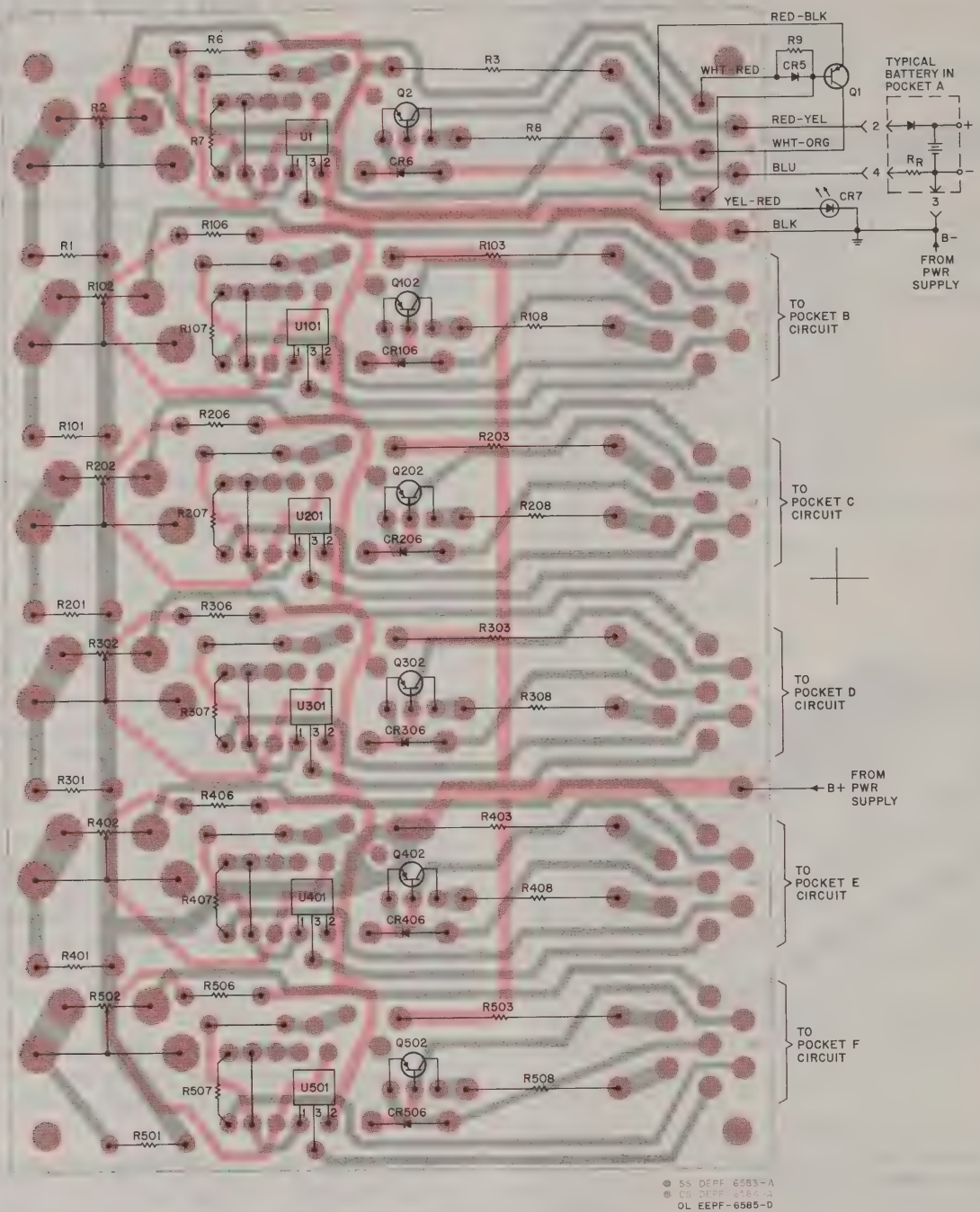
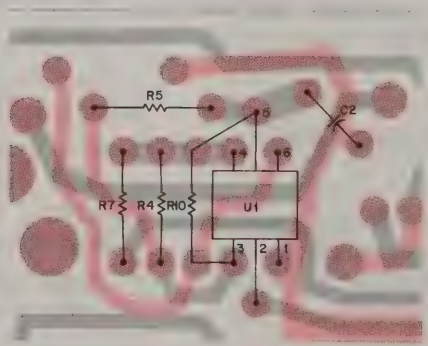
Instruction Manual
68P81101C71-D

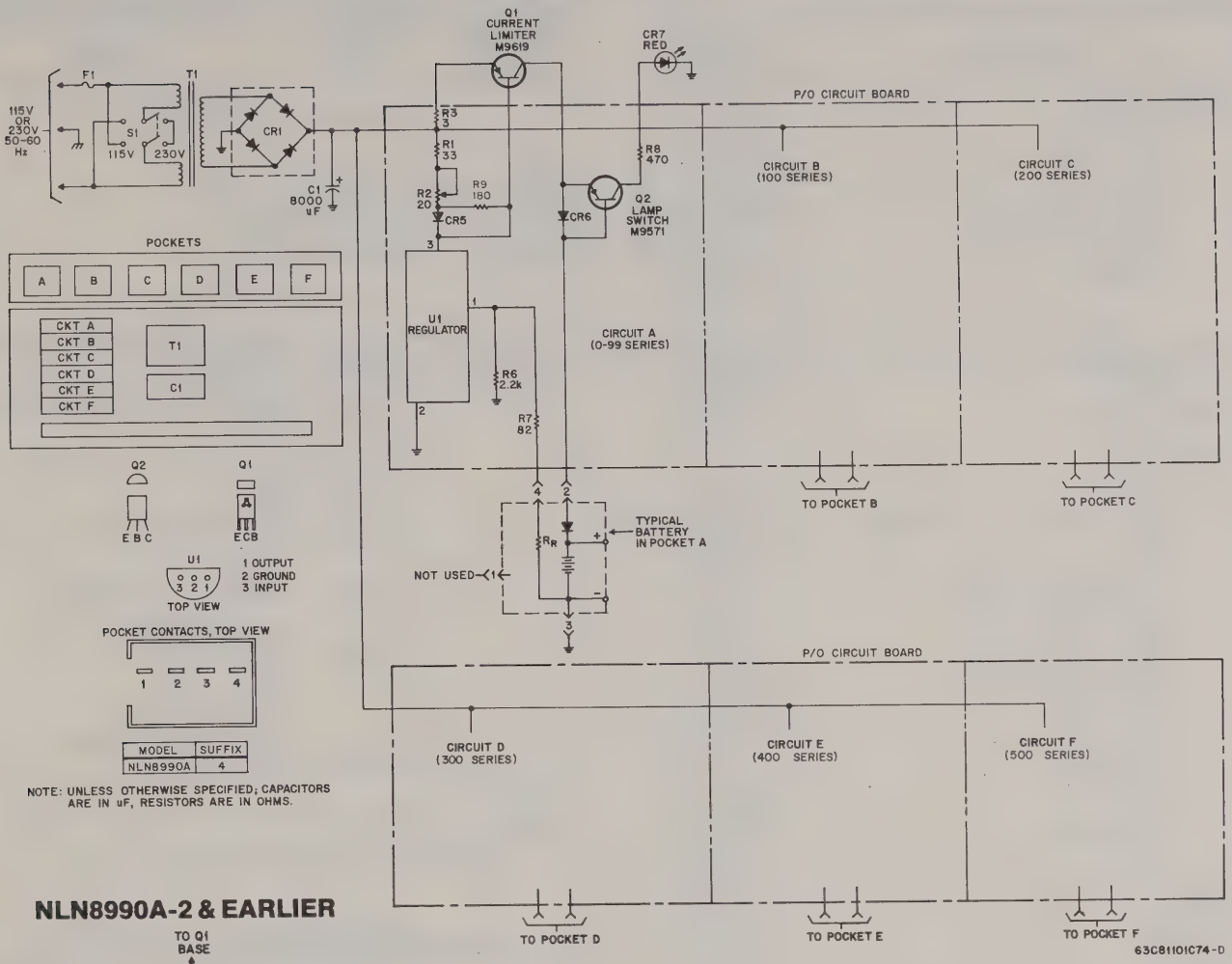
CIRCUIT BOARD DETAILS (Component Side)
NLN8990A-3 & LATER



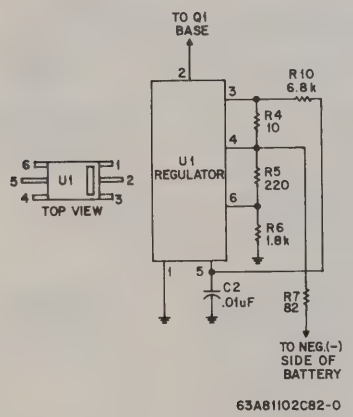
NLN8990A-2 & EARLIER



SCHEMATIC DIAGRAM
NLN8990A-3 & LATER



NLN8990A-2 & EARLIER



DC VOLTAGE MEASUREMENTS

BATTERY	LOCATION									Charging Current (Nominal)
	C1	Across R3	Q1 Emitter	Q1 Collector	Q1 Base	Q2 Collector	CR7	Pin 4 Battery	U1 Pin 1 *	
NO BATTERY	21.0	0	21.0	21.0	20.0	0.0	0	5.0	5.0	0
NLN8831 NLN8834	19.5	0.20 0.40	19.0	10.0	18.8	10.0	2.0	4.62	5.0	67 mA 91 mA
NLN8832 NLN8835	19.0	0.40 0.60	18.1	10.1	17.8	10.1	2.0	4.1	4.9	130 mA 178 mA
NLN8833	17.0	0.70	15.8	10.2	15.0	10.1	2.0	2.6	4.9	255 mA

* Pin 4 on units suffixed NLN8990A-2 & earlier.

NOTES:
1. All voltages are typical, measured with a Motorola S1063A Multimeter from given location to common ground except for the voltage measured across R3.
2. Input is nominal 115 Vac, 60 Hz.

MECHANICAL

NLN8990A/NTN4832A 14-Hour Multi-Charger TPLF-1004-B

NOMENCLATURE	MOTOROLA PART NO.
ASSEMBLY, Housing;	0105950C79
contains: COVER, Charger	1505274D01
FASTENER, Clip	4205722C01
CLAMP, Cable	4282143C03
PLUG, LED	2805782C01
SCREW, Phillips, 4-40 × 3/8"	0300400106
SCREW, Tapping, 8-32 × 3/8"	0300131632
SCREW, Machine, 4-40 × 1/4"	0300136774
WASHER, #4	0400007555
BRACKET, Mounting	0705336D01
	0705831L01
	0705831L03
ASSEMBLY, LED;	0105958B03
contains: LUG, Terminal	2905916C01
HOLDER, LED	4205780C01
ASSEMBLY, Contact;	0105950J35
contains: STRIP, Contact	3905709C01
CONTACT	3905708C02
ASSEMBLY, Base	
contains: NUT, Self Clinch	0205411D02
LUG, #4	2900005293
STRIP, Terminal; 1/4	3100139500
PLATE	6405946C03
NUT, Hex; 4-40 × 1/4" × 3/32"	0200007019
NUT, Hex; 8-32 × 5/16" × 1/8" × 5/32"	0200129892
SCREW, Machine; 4-40 × 3/4"	0300138127
SCREW, Machine; 6-32 × 1/2"	0300129071
SCREW, Machine; 4-40 × 1/2"	0300136998
SCREW, Machine; 4-40 × 3/8"	0300400106
SCREW, Machine; 8-32 × 1/2"	0300134143
SCREW, Tapping; 8-32 × 3/8"	0300131632
WASHER, Flat	0400007555
WASHER, Insulating	0405825C01
HOLDER, Fuse	0905724C02
CORD & PLUG, AC	3084406H01
CLAMP	4205933C01
RETAINER, Cable	4282018H01
BUMPER, Rubber	7505413D01
CLAMP	4205396D02
SCREW, Machine; 8-32 × 5/16"	0300136989
WASHER, Flat	0400114970
LABEL, Information	5405005E09
LABEL, Caution	5405755D01
LABEL, Fuse	5482499J08
LABEL, Warning	5482500J01

ELECTRICAL

NLN8990A/NTN4832A 14-hour Multi-Charger TPLF-0988-D

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, Fixed:
C1	2383093G13	8000uF – 10 + 150; 35V
		DIODE: See Note I
CR1	4884751H02	Bridge
CR2, 3, 4	-----	Not Used
CR5	4805490G02	Silicon
CR6	4882466H13	Silicon
CR7	4805776C01	LED, Red
		FUSE:
F1	6500890033	1½ Amp; 250V
		TRANSISTOR: See Note I
Q1	4800869619	PNP; type M9619
Q2	4800869571	PNP; type M9571
		RESISTOR, Fixed: Ω ± 5%; ¼W
R1	0611009C13	33
R2	1883168C10	Var, 20 ± 20%; 3W
R3	1782177B01	3 ± 10%; 5W
R6	0611009C57	2.2k
R7	0611009C23	82
R8	0600126C41	470 ± 10%; 1W
R9	0600124A31	180
		SWITCH:
S1	4083526D02	Slide
		TRANSFORMER:
T1	2505339D01	Power, Resistance Pin 1 to 2: 6.9Ω Pin 3 to 4: 7.7Ω Pin 5 to 6: .065Ω
		INTEGRATED CIRCUIT:
U1	5105469E01	Voltage Regulator

NOTE:

I. For optimum performance, order replacement diodes and transistors by Motorola part number only.

BACK-DATING INFORMATION

ITEM NO.	REF. SYMBOL/CHANGES	CHANGED TO
NLN8990A	R10 ADDED	NLN8990A-1
NLN8990A-1	Plating changed to relocate R10, R110, R210, R310, R410, & R510 to component side of circuit board.	NLN8990A-2
	R6 WAS 0600124A57, 1.8k	
	U1 WAS 5184320A69	
NLN8990A-2	C2, R4, R5 & R10 DELETED	NLN8990A-3
NLN8990A-3	C1 WAS 2383093G13, 8000uF	NLN8990A-4
	CR5 & 6 WAS 4882466H13	
	R1 WAS 06600124A13, 33	
	R2 WAS 1883168C10, 20	
	R3 WAS 1782177B01, 3	
	R6 WAS 0600124A57, 2.2k	
	R7 WAS 0600124A23, 82	
	R8 WAS 0600124C41, 470	
	R9 WAS 0600124A25, 100	
NLN8990A-4	AS SHOWN	

MOTOROLA INC.

MANUAL REVISION

for
Manual No. 68P81108C11-A
REMOTE SPEAKER MICROPHONE
FOR STX PORTABLE RADIOS

This revision outlines changes that have occurred since the printing of the manual. Use this information to supplement your manual. Installation of these changes in earlier equipment is not necessary except as recommended in Motorola Service and Repair Notes (SRN's).

REVISION DETAILS

NO.	CHANGE AFFECTS	ITEM NO.	SUFFIX
1	General Information	----	—
2	Electrical Parts List	----	—

CHANGES

NO.

Add the following models to your manual:

NMN6138B, Long Coiled Cord
NMN6142B, Short Coiled Cord

NO.	REF. SYM.	ACTION	MOTOROLA PART NO.	DESCRIPTION
2	LS1	changed to	5005269T03	SPEAKER: 1.75", 4Ω (B models only)

MOTOROLA INC.

REMOTE SPEAKER MICROPHONE

FOR STX® PORTABLE RADIOS

MODEL NMN6138A, LONG COILED CORD
MODEL NMN6142A, SHORT COILED CORD

1. DESCRIPTION

The Remote Speaker Microphone is an accessory item for all STX portable radios. The microphone contains a speaker, microphone, push-to-talk (PTT) switch, High/Low switch, and a coiled cable. The cable is terminated with a special plug which attaches to the accessory connector on the side of the radio.

When the Remote Speaker Microphone is attached to the radio, the speaker in the radio is disabled and the accessory speaker is enabled. Sound travels out the front of the Remote Speaker Microphone unit. Similarly, the accessory microphone is connected to the transmitter, and the accessory PTT switch now energizes the PTT relay in the radio. The microphone cartridge is located in the front of the unit. When transmitting, the operator must speak into the microphone grille (refer to Figure 1). The radio microphone and PTT switch are still operational, but you must listen to the accessory speaker. The Remote Speaker Microphone will perform best if it is worn as shown in Figure 2.

The High/Low switch toggles the speaker volume level and microphone cartridge sensitivity. With the switch in one position, speaker volume range is high and microphone cartridge sensitivity is either highest or decreased. (The microphone cartridge sensitivity may be decreased at a Motorola Service Center to suit a particular operating environment, see MICROPHONE SENSITIVITY ADJUSTMENT). With the switch in the other position, speaker volume range is low, and microphone cartridge sensitivity is highest.

NOTE

Observe the safety information in the appropriate radio operator's manual.

2. HANDLING PRECAUTIONS

To avoid damage to circuits, observe the following handling, shipping, and servicing precautions.

A. Before servicing a Remote Speaker Microphone, momentarily place both hands on a bare metal, earth-grounded surface. This will discharge any static charge which may have accumulated on the person. This procedure should be repeated throughout servicing, particularly after moving around within the service area.

Figure 1. Transmit

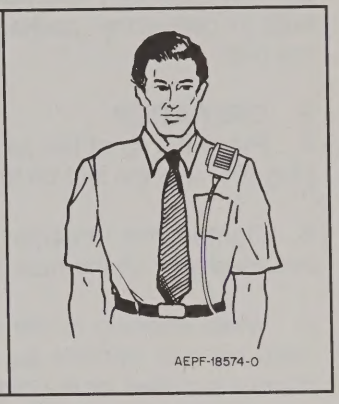


Figure 2. Receive

NOTE

Wearing a conductive wrist strap (Motorola No. RSX-4015A) will minimize static build-up during servicing.

WARNING

When wearing a conductive wrist strap, be careful near high voltage sources. The good ground provided by the wrist strap will also increase the danger of lethal shock from accidentally touching high voltage sources.

B. Whenever possible, avoid touching any electrically conductive part of the unit with your hands.

C. When servicing a unit, avoid carpeted areas, dry environments, and certain types of clothing (silk, nylon, etc.) that contribute to static build-up.

D. All electrically powered test equipment should be grounded. Apply the ground lead from the test equipment to the unit before connecting the test probe. Similarly, disconnect the test probe before removing the ground lead.

E. If the microphone cartridge is removed from the unit, place it on a conductive surface, such as a sheet of aluminum foil which is connected to ground through 100k ohms of resistance.

WARNING

If the aluminum foil is connected directly to ground, be cautious of possible electrical shock from contacting the foil at the same time as other electrical circuits.

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Instruction Manual
68P81108C11-A

F. When soldering, be sure the soldering iron is grounded.

G. Before replacing circuit components or touching the microphone cartridge, be sure to discharge any static build-up. Since voltage differences can exist across the human body, it is recommended that only one hand be used if it is necessary to touch the microphone cartridge and associated wiring.

H. Replacement microphone cartridges should be kept in conductive packaging until they are placed in the unit.

3. OPERATION

A. Place the lip of the accessory speaker microphone plug (P1) into the slot on the top of the radio.

B. Tighten the threaded stud on the plug into the threaded hole on the radio.

C. While listening to the accessory speaker, turn the radio on and operate as explained in the operating manual supplied for the radio.

4. DISASSEMBLY

If it is necessary to disassemble the microphone, use the following disassembly procedure to gain access to the internal parts. (Refer to the Exploded View Diagram for details).

A. Loosen the four captive screws (34) on the back cover assembly. Do not completely remove the captive screws. Remove the back cover assembly.

B. Remove the seven socketed wires from the PC board using tweezers to gently pull each wire from its pin.

C. Unsolder the black lead from the ground plane on the PC board. Unsolder the red and green leads of the High/Low switch from the PC board.

D. Remove the screw (21) from the tab of the PC board.

E. Remove the PC board assembly (26) from the microphone housing. The speaker and microphone cartridge assemblies are attached to the PC board.

F. Reverse the preceding steps to reassemble the microphone. Refer to the torque specifications before securing the screws. Inspect all surfaces and clean when necessary to remove any foreign material that would impair proper assembly.

APPLICATION	TORQUE (IN/LB)
HIGH-LOW SWITCH NUT	5
ALL SCREWS	3

TORQUE SPECIFICATION TABLE

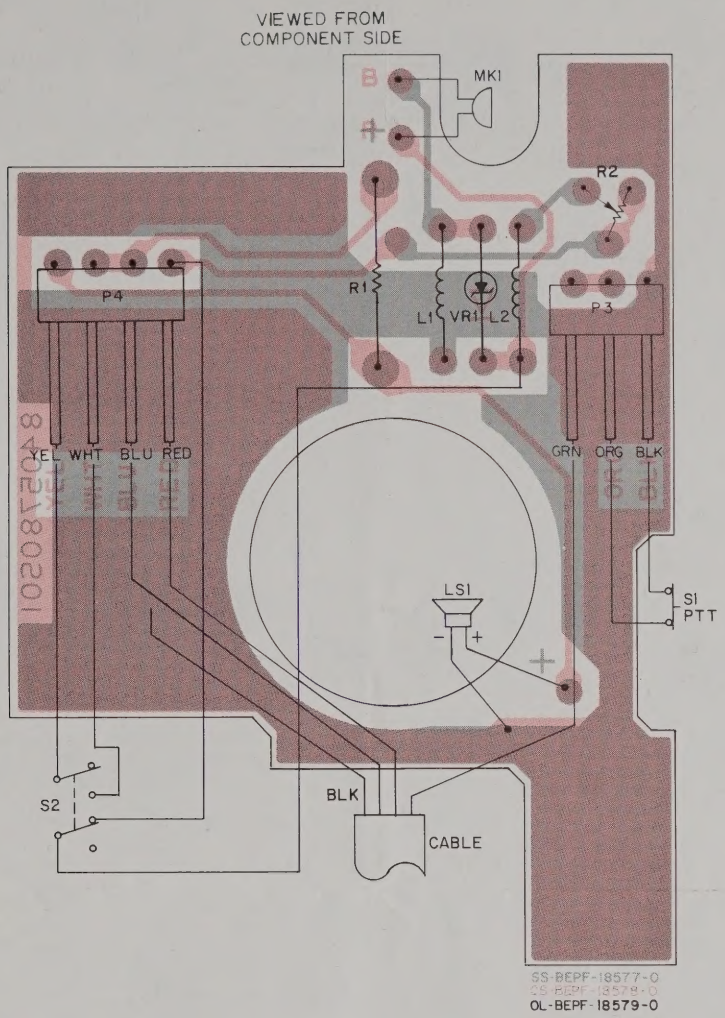
5. MICROPHONE SENSITIVITY ADJUSTMENT

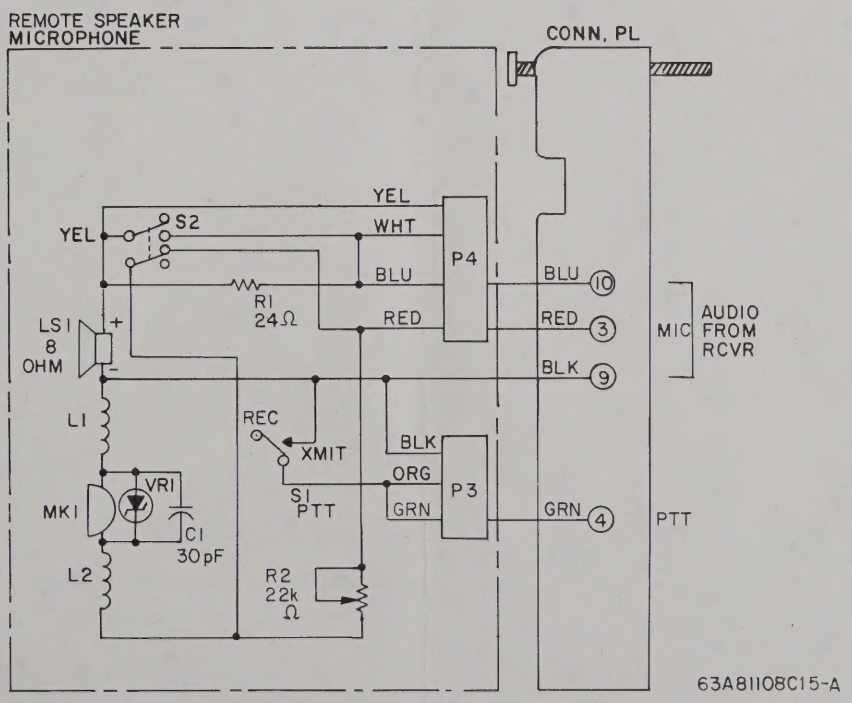
The Remote Speaker Microphone contains a trim pot which may be adjusted to decrease the sensitivity of the microphone cartridge. The microphone cartridge sensitivity is set at the highest level before leaving the factory. The trim pot (R2) is located on the microphone printed circuit board, and requires removal of the back cover for access. Adjusting the trim pot counter-clockwise will decrease the microphone cartridge sensitivity.

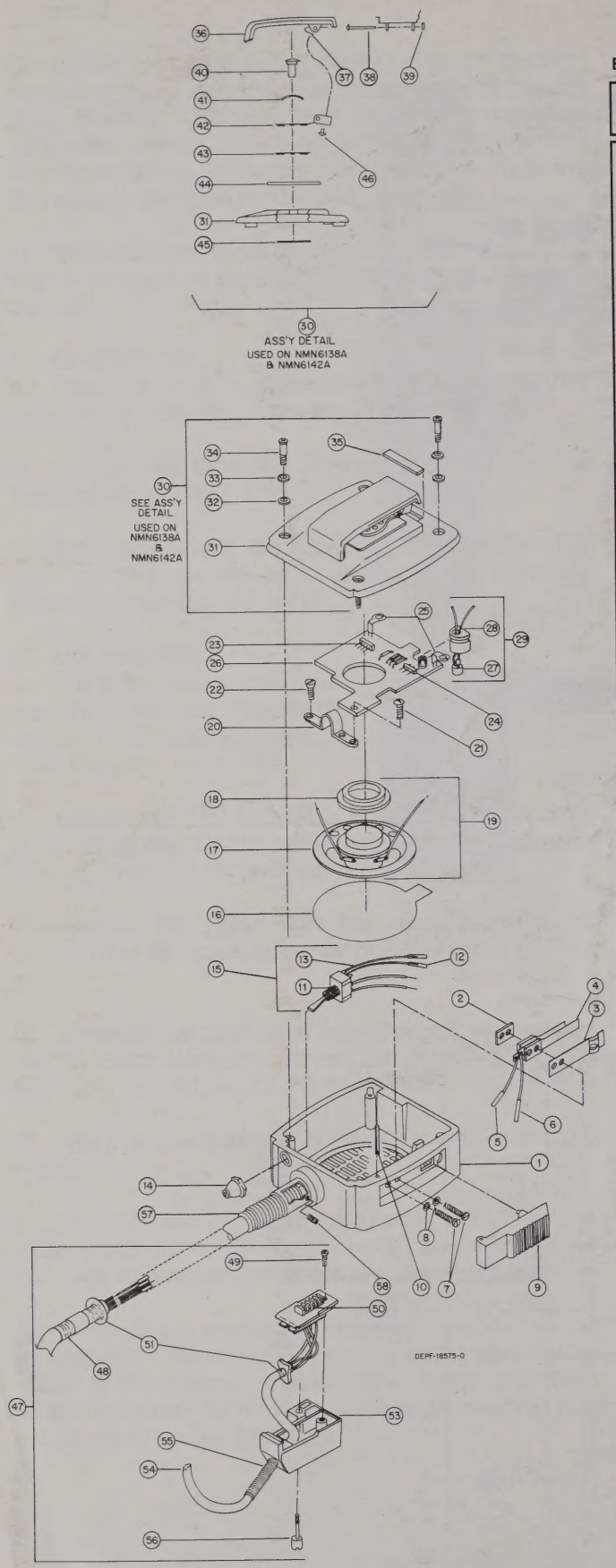
ELECTRICAL PARTS LIST

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR:
C1	2100864521	30pF + 10%; N750
		SPEAKER:
LS1	5005471N01	1.75", 8Ω + 15% @ 1kHz
		MICROPHONE:
MK1	5005227J02	Cartridge, Imped: 1.6kΩ + 30% @ 1kHz
		CONNECTOR:
P3	2805513G03	3-Pin
P4	2805513G04	4-Pin
		INDUCTOR:
L1, L2	2482723H04	290nH Choke
		RESISTOR:
R1	0605139G14	24Ω + 5%, 1/2 W
R2	1805500L08	Pot; 22kΩ + 20%, 100V
		SWITCH:
S1	4005881L01	Push SPST, Push-To-Talk
S2	400535A01	Toggle DPDT, High/Low
		DIODE:
VR1	4883461E32	Zener; 23.8V
NONREFERENCED ITEMS		
	8405780S01	Board, Circuit

CIRCUIT BOARD DETAIL







EXPLODED VIEW PARTS LIST

ITEM NO.	MOTOROLA PART NO.	DESCRIPTION
1	1505395S02	HOUSING
2	6482826E01	PLATE, PTT Back-up
3	4182856E01	SPRING, PTT Back-up
4	See Note	SWITCH, PTT (S1)
5	0105954P08	WIRE, PTT; Orange, w/Socket
6	0105954P09	WIRE, PTT; Black, w/Socket
7	0300129172	SCREW, PTT; #3-48 x 3/8"; Slotted
8	0400007681	LOCKWASHER, #3
9	3883388G03	LEVER, PTT
10	2205614E01	PIN, PTT Pivot
11	See Note	SWITCH, High-Low (S2)
12	0105954P06	WIRE, High-Low; White, w/Socket; see item 15
13	0105954P07	WIRE, High-Low; Yellow, w/Socket; see item 15
14	0283676D01	NUT, High-Low; see item15
15	0105950Q95	ASSEMBLY, Switch, High-Low; contains items 11 thru 14
16	3505350S01	FELT, Speaker/Microphone
17	See Note	Speaker (LS1)
18	7505349S01	BOOT, Speaker
19	0105954P53	ASSEMBLY, Speaker; items 17-18
20	4205143B01	CLAMP, Strain Relief
21	0300115613	SCREW, #4-40 x 1/4"; Slotted
22	0300129286	SCREW, #4-40 x 1/4"; Slotted, Flat
23	See Note	CONNECTOR, 4-Pin (P4)
24	See Note	CONNECTOR, 3-Pin (P3)
25	0705351S01	BRACKET
26	See Note	BOARD, Circuit; includes items 23 & 24
27	See Note	*MICROPHONE, (MK1)
28	7505348S01	BOOT, Microphone
29	0105954P19	ASSEMBLY, Microphone; includes items 27-28
30	0105958P37	ASSEMBLY, Cover, w/Belt Clip; includes items 31 thru 46 (Used on NMN6138A)
	or 0105959P60	ASSEMBLY, Cover, w/Belt Clip; includes items 31 thru 46 (Used on NMN6142A)
31	-----	*COVER; Order item 30
32	0482650D06	WASHER, #4; Flat
33	0400009743	LOCKWASHER, #4; Split
34	0382210E01	SCREW, #4; Captive
35	3305216K30	NAMEPLATE, NMN6138A (Used on 0105958P37)
	or 3305216K31	NAMEPLATE, NMN6142A (Used on 0105959P60)
36	-----	*CLIP, Pocket; Order item 30
37	-----	*SPRING, Clip; Order item 30
38	-----	*PIN, Clip; Order item 30
39	-----	*NUT, Spring; Order item 30
40	-----	*RIVET; Order item 30
41	-----	*WASHER, Spring; Order item 30
42	-----	*BRACKET, Detent; Order item 30
43	-----	*PLATE, Detent; Order item 30
44	-----	*PLATE, Detent; Order item 30
45	-----	*WASHER, Flat; Order item 30
46	-----	*RIVET, Nylon; Order item 30
47	0105957P37	ASSEMBLY, Cable; Long, includes items 48 thru 57 (Used on NMN6138A)
	or 0105959P59	ASSEMBLY, Cable; Short, includes items 48 thru 57 (Used on NMN6142A)
48	-----	*RING, Outer; Order item 47
49	0300136666	SCREW, #2-56 x 1/4"
50	0105956155	CONTACT, Terminal Block
51	-----	*EYELET; Order item 47
52	-----	*RETAINER, Cord; Order item 47
53	-----	*HOUSING, Connector; Order item 47
54	-----	*CABLE, Coiled; Long (Used on 0105959P59); Order item 47
	or -----	*CABLE, Coiled; Short (Used on 0105957P37); Order item 47
55	-----	*SPRING, Strain Relief; Order item 47
56	0305172D01	SCREW, #6; Captive
57	0105958P36	*ASSEMBLY, Strain Relief; Order item 47
58	0300009718	SET SCREW, Strain Relief; 4-40 x 1/8"

NOTE: Refer to Electrical Parts List for part number and description.
* Not field replaceable; order parent assembly number given.